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BRIEFLY TOLD.

ARC LIGHTING IN NEW YORK.—Since the wane of the golden days when the purveyors of electricity in the metropolis were obtaining $255.50 per annum for each arc light supplied, there has been a wonderful lack of that harmonious feeling among them which is always to be noted when there is profit to divide, and when those who are anxious for the profit can see their way clear to combining for its division. With the multiplication of companies, however, came divisions in the councils, and cuts in the rates, until now—according to the latest developments before the Gas Commission in the shape of bids—New York may take its pick out of bids ranging between 60 cents (for two lights on the Harlem Bridge) and 19 cents for each arc. Of course, all this is greatly to the benefit of the metropolitan treasury, even if it is contrariwise in respect to the profits of the electricians; but, of course, New York can stand it without demur. The Gas Commission met last Tuesday to award the contracts, but the session ended without any other result than the passage of a resolution directing the Corporation Counsel to make inquiry into charges made by some of the bidders against others who submitted figures in the competition. Perhaps at the meeting set for to-morrow the affair may be settled, and it is high time that it was, for several weeks have been wasted in the attempt to get at an understanding. The bids submitted also reveal an interesting condition of affairs in respect of the attitude assumed by the most influential electric light companies towards the proposed compulsory use by them of the subways. From the figures asked (these will be found in our item columns) it will be noted that lights to be supplied from subway distribution are billed at from 9 to 10 cents higher than those that are to come from overhead wires. This is but another illustration of the old saw that while a horse may be led to the water, he cannot be always made to drink.

A GOOD APPOINTMENT.—The Western Gas Association was heartily congratulated by the fraternity when, in 1888, it introduced to them Prof. Thos. C. Mendenhall, President of the Rose Polytechnic Institute, of Terre Haute, Ind., in the capacity of a lecturer. Indeed, we have often heard it remarked that his lecture on that occasion on "Photometric Standards" was one of the most interesting dissertations that had been delivered on the subject. Of course, we know that that verdict or expression of opinion may carry but little of praise, since photometry is not generally considered a fascinating topic, no matter how greatly scientists may or do become embroiled over the theme as to what exact relation photometry, as at present practiced, bears to the ends sought to be gained. In any event, however, Prof. Mendenhall was voted a success in respect to his effort of '88, and *the* disappointment of the Western meeting in '89 was the Professor's failure—unavoidable, and from a sad cause—to speak before the Association on "The Nature of Light." Our purpose at this time is to congratulate the distinguished gentleman—and we think gas men of all parties will assist in the acclaim—on his appointment by President Harrison to be Commissioner-in-Charge of the United States Coast Survey. Prof. Mendenhall is peculiarly well fitted for the position, which will at once be conceded when it is remembered that, having resigned from the Ohio University (1878) to take the chair of Professor of Physics in the Imperial University, Tokio, Japan, he returned to this country in 1881, and a year later organized the Ohio State Weather Bureau Service, and subsequently devised a system of weather signals for display on railroad trains. In 1884 he became a Professor in the United States Signal Service, and established stations in the United States for the systematic observation of earthquake phenomena—we should have said also that during his stay in Tokio he organized the Tokio Seismological Society. He resigned from the Signal Service to accept the Presidency of the Rose Polytechnic Institute, from which he retires to take charge of one of the most important divisions of the country's service. That he will fill the place worthily goes without saying.

GAS WINS AT SCHENECTADY, N. Y.—The Schenectady (N. Y.) Gas Light Company has been lighting the city hall, engine houses, and other public buildings, without a time contract, at the rate of $1.75 per thousand, and the authorities appeared to be satisfied with the service. Last year the gas thus used cost the city $500. In the meantime the local Westinghouse branch managed to secure representation in the Board of Aldermen, and this worthy, about a month ago, quietly stole in a resolution to award the lighting of the city hall to his backers—they to replace each gas burner with a 16-candle power lamp—the cost of same to be $400 per annum. When the matter came up in open session the proposition was referred back to the Lamp Committee, who were instructed to ask for bids for the service from the gas and electric companies. Capt. White, on behalf of the former, offered to supply *all*

the public buildings at $1.60 per thousand, in consideration of a 3-years contract. The Westinghouse folks bid $400, and the Captain was awarded the contract by a vote of 14 to 1. The move was cleverly made.

THE EDUCATION OF GAS ENGINEERS.—The paper read before the last meeting of the Western Association, by Mr. Jno. Gimper, on the "Education of the Gas Engineer," has attracted attention abroad, as well as aroused interest at home. This shows that even what are considered "hackneyed subjects," simply because they have been written upon before, are often those that are best calculated to take the prize upon the paper list—which hint is respectfully referred to those who are "thinking about" writing a paper for the coming meeting of the American Association. The London *Journal*, of the 18th ult., devoted its leading editorial to this subject, and this is what it said:

One of the most interesting subjects discussed at the recent meeting of the Western Gas Association of the United States was that of the education of the gas manager, upon which a paper was read by Mr. Gimper; and as this is a matter that has been much debated in England, it is very probable that English gas managers may be interested to learn what their American brethren think of it. Also, by stating very briefly the position of the question on this side, we may be able to help our American friends to a clear opinion respecting a matter that is very liable to be misunderstood. The direction taken by the Western Americans in their discussion of the question was quite a practical one. They very quickly made up their minds that a school of gas engineering is needed; and they appointed a committee of three to interview Professor Mendenhall, head of a Western college, and learn his views respecting the possibility of their introducing gas engineering as a subject in the college course. We have not yet learnt the result of this somewhat precipitate action, but are shrewdly of the opinion that it is too hurried to come to anything of permanent value. A problem of this kind cannot be settled off-hand; and we should expect more of the action of the Western men if they had taken until the next meeting of the Association to consider and report. From experience of the handling of this question in England, we can assure them that it not so easy to settle as it appears at first sight. It is simple enough to say that as electrical engineering is taught in schools and colleges, so ought gas engineering to be included in the *curriculum* of some educational establishments; but the simplicity disappears as soon as one pauses to think what gas engineering really is, and wherein it differs from electrical science. As a matter of fact, it is a calling or a business rather than a study. Many men learn the elements of electricity as they do of geology or optics, without meaning to practise business of which these sciences are the theoretical foundations. Nobody ever wants to learn engineering, however—especially a particular branch of it—except with the purpose of getting his living by it. Further, the more closely gas engineering is examined, the less easy it is to define wherein it so differs from other branches of engineering or chemical industry as to require a separate doctrine. The gas engineer is in reality only a hybrid, produced by blending civil and mechanical engineering with chemistry. Take any intelligent, receptive young man with a fair training in engineering and some ideas respecting chemistry, and he will make a good gas engineer after spending a few years in a well conducted gas works. There is no mystery about it. The best gas engineers have been made by the force of circumstances acting upon a suitable material. Some men have no mechanical sense, and consequently would never turn out good gas engineers even if they were to try, which is unlikely. The worst of gas managing as a calling is that so much of it is routine, which any man of reasonable force of character and intelligent enough to "keep his end up" can follow. Consequently, there is an ever-present temptation to cheeseparing boards of directors and public authorities to get rid of managers with the training and requirements of gentlemen and rub along with promoted stokers. Far be it from us to depreciate the value of the man who rises from the ranks. He occasionally has innate good principles which many men lack who walk about disguised as gentlemen; and he sometimes improves himself as he goes on, until at last it is difficult to tell off-hand that he is a "self-made" man. Genius, we know, leaps all obstacles. If a man is a born engineer he will rise to it somehow; and unless a man has it in him he will never become a real live engineer, though he has all the college training to be obtained in the universe. Let us not deceive ourselves, however. Genius is the rarest thing on earth, and combined with wisdom is beyond rules as it is without price. Fortunately, while there is no human occupation which genius does not occasionally adorn, there is also none which a man with ordinary capacity may not do reasonably well in, if he has the proper equipment. And the equipment of a gas engineer is simply that of an educated man of his epoch whose bent has been mechanical or chemical, as the case may be, and whose circumstances have turned his attention to gas making.

In England, but for the recent troubles of the Gas Institute, there would have been in operation ere this a scheme for supplementing and continuing the work begun by Mr. Lewis T. Wright, for the City and Guilds of London Institute. The idea of this movement was to provide means of instruction whereby men actually engaged in the gas industry might supply the deficiencies of their positions. There are at this moment dozens of gas engineering schools in full swing in different parts of the United Kingdom, and indeed the number might be enlarged to hundreds for all divisions of the earth. We mean the gas works where a scientific spirit prevails, through the example of the head, and where, accordingly, any young man who may occupy a confidential position near the chief, takes in gas engineering with every breath. These are places where routine is the servant and not the master; where nothing is done by rule-of-thumb, or merely because it has been so; and where every promising new theory in gas engineering promulgated by the author of a technical paper published in any part of the world, is weighed, and, if possible, tested at the earliest moment. We want no better college of gas engineering than some of these establishments which we could name. A little outside aid is wanted, however, by young men employed in small or old-fashioned works under managers who cannot or will not help them to learn in a proper manner the principles of gas manufacture and distribution according to the best practice of the day. Manuals are very helpful so far as they go; but the best treatise contains much that begins to grow old-fashioned from the moment of its appearance in print. Technical journals, moreover, cannot devote much space or frequently, to explanations of matters interesting to students; and papers read before professional societies seldom touch them very closely. The lecturer, however, who would be a man both of theory and practice, knows exactly what position is occupied at the moment by the principles which he has to expound, and can give his pupils the "time of day" better than anybody else.

It has been tolerably well established, in English discussions of this subject, that technical instruction of the kind herein described should be confined, when it is given at all, to men actually committed to the gas industry for their livelihood. There is no sense in attracting young men to gas engineering as though there was an unlimited scope for any number of them in this employment when they have done their instructional course. Civil engineers in general practice have much to answer for in flooding the world with half-trained youths, whom they have taken into their offices for the sake of a premium, not intending to provide a career for them afterwards. This is an old grievance which we will not discuss afresh. More mischief of the same kind has been done by electricians of the later type, who have made a fine market out of their supposed command of the entrance to a new occupation for "sons of gentlemen." It would be the height of folly as well as injustice for gas engineers to do the same thing, without the premiums, by inviting all and sundry to learn the elements of their technology. We cannot altogether approve of those engineers who, with the best capacity for bringing up young men to be a credit to their profession, make a point of not taking pupils; although it is easier to sympathize with them than to pardon the premium hunters who fill their offices with useless loungers. The premium system is and ever has been, at fault. At the same time a supply of recruits must be kept up for filling vacancies; and it is difficult to see where these are to be trained if not in engineers' offices. Sons and young relatives are the natural stock from which the ranks of all professions and trades ought to be manned; the good old rule that the son should follow his father's calling being observed in all cases when no reason exists to the contrary. We have on a former occasion pointed out the dangerous consequences that are likely to follow the policy of parsimonious gas-works-owning corporations, which does not offer a prospect of reasonable remuneration for trained and educated gas engineers; but it is only fair that the other side of the question should not be lost sight of, and that a sufficient supply of men of the proper stamp should be maintained. There is nothing that will so much tend to drive employers back upon the untrained "self-made" man out of the works, as disappointment caused by the failure of a half-trained man rushed through an engineer's office, and floated off upon a glowing testimonial, the value of which has been duly considered in the premium paid at his start. There have been factories for turning out rubbish of this discription by dozens; so that there could not be a competition for an open appointment in a gas works without a candidate recommended from a well known nursery, ready to repeat, if he could get the opportunity, the bad lessons he had learnt from his first trainer. Happily, it may be said that this state of things is of the past, and there are now very few British gas engineers who would take a pupil unless they really wanted help, or merely for the sake of the premium, and with the intention of gettting rid of the hapless youth at the earliest possible moment.

The discussion of the education of gas managers has become mixed up with the question of their employment; but we do not apologize for the seeming confusion, because, as we stated to begin with, gas engineering is more properly to be described as an occupation or business than a science capable of being studied for its own sake. We hold that if our Western American friends try to make it a subject in a college course, they will perpetuate a blunder which cannot possibly have good results. There is no separate chemistry for gas managers, any more than there is a separate multiplication table. They are required, in the course of their particular industry, to make specialized applications of general principles; but these cannot be taught outside the business in which they arise, or by anybody except a man who practises them.

Modern Gas Analysis.

The London *Journal*, in noting that two new forms of apparatus for conducting the analysis of coal gas, flue gas, and any similar gaseous mixtures, have been recently described, goes on to say that although their principal claim to novelty rests rather in the modification of details than in any new departure from the lines of procedure previously followed, they are to be welcomed as attemps to render more easy and accurate a process with which every gas engineer may well be acquainted—*i. e.*, the partial analysis, at any rate, of a sample of illuminating or heating gas.

The first form of apparatus is that used by Mr. Charles J. Wilson, of the University College, London, in connection with the trials of motors

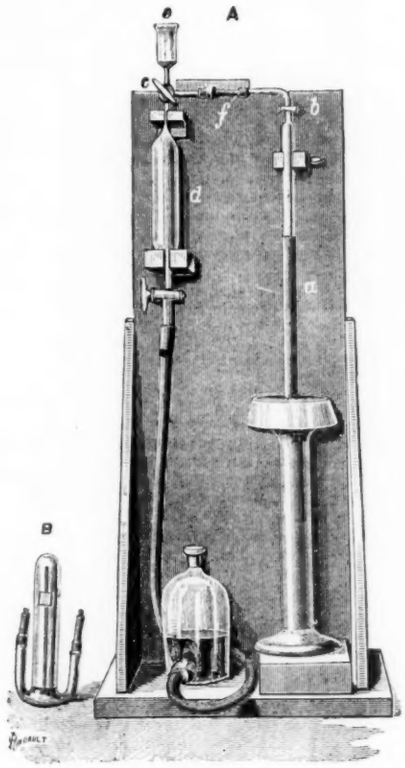


Fig. 1.

for electric lighting conducted by the Society of Arts; and it was by its means that some analyses of London gas, recently published, were obtained. In the accompanying engraving (fig. 1), *A* is the apparatus, and *B* a tube for taking a sample of gas; *a* being the eudiometer, shown partly filled with mercury, and *d* the laboratory vessel. There is a tap at *b*, and a three-way cock at *c*; and the connection between the two vessels is made by means of a piece of thick india-rubber tubing at *F*. The lower end of the eudiometer is sealed in mercury contained in a cylindrical vessel, with an enlarged head as shown, the height of which can be adjusted by blocks as desired. A deep funnel or cup is provided in connection with the three-way cock *c*, and a mercury bottle of the usual construction is connected to the other end of the laboratory vessel by means of stout rubber tubing. The sampling tube *B* consists of a closed piece of wide glass tube having two small tubes attached, as shown, to the base, and turning up on either side, so as to give the whole an anchor-like shape. It is completely filled with mercury before use, and is connected with the gas supply by means of a piece of rubber tubing attached to one of the small tubes. The connecting tube must be filled with the gas to be tested—by aspiration if necessary, or by allowing the gas to escape freely through it before connecting to the sampling tube. The connection being made, the vessel is so inclined as to allow mercury to flow out of the opposite tube until only enough remains to seal the sample, and the rate of escape of mercury can be regulated as desired. The side tubes can then be filled with mercury and fitted with caps.

In order to conduct an analysis, a sufficient quantity of gas is conveyed from the sampling tube to the eudiometer, and its volume measured. The apparatus being in the position shown, with the stopcocks *b* and *c* open, the gas passes over into the laboratory vessel *d*, followed by sufficient mercury to drive all of the gas out of the capillary tube. The two ends of the rubber tube at *f* are made funnel-shaped, so as to grip the tube; and by lowering the eudiometer a little when gas is passing from *a* to *d*, and raising it for the passage in the other direction, the whole of the gas is driven out of the tube by the current of mercury. The cock *b* is then shut, and the appropriate reagent is poured into the cup *e*. It is admitted into the laboratory vessel by the three-way cock. The tap at the base of the laboratory vessel is closed, and the reagent left in contact with the gas until the reaction is complete. When this is the case the mercury bottle is placed on the upper shelf shown near *f*; the cocks are opened, and the gas is forced back into *a*. When the reagent (which floats on the top of the mercury) rises to *c*, the three-way cock is turned so as to allow it to be driven back into *e*. The capillary tube can be cleared by driving mercury over; and the amount of absorption arrived at by reading off the volume of gas in the eudiometer. The used reagent is then removed from *e*, and replaced by another; and the gas can thus be treated for each of the absorbable constituents in succession. The means adopted for exploding the residual hydrogen, etc., are not described.

The sampling tube *B* is evidently a useful apparatus for taking and conveying samples of gases. It is an advantage that the whole of the gas should be displaced from the connecting tube. On the other hand, there are some defects about the apparatus. So far as one may judge from the drawing a limited amount of agitation could be given to the laboratory vessel when charged with a sample of gas; but it does not give the facility for agitating the contents that is afforded by a Bunte burette. The withdrawal of a used reagent and the washing out of the cup *e* is rather inconvenient in the case of substances such as potash or fuming sulphuric acid. Indeed, for dealing with chemicals that are energetically acted upon by the air, such as potash, pyrogallate or cuprous chloride, there is nothing like the Hempel bulbs, which are, however, subject to the objection that it is difficult to clear the capillary tubes and connections. So that with careful operation it is possible that more accurate results would be secured with the Wilson apparatus.

We now pass on to the second arrangement of gas analysis apparatus alluded to at the commencement. This is described in a paper recently read before the Newcastle Section of the Society of Chemical Industry, by Mr. J. E. Stead, who stated that several times during the past ten years he had made communications to the Iron and Steel Institute, describing various forms of gas testing apparatus which he had designed for the purpose of examining the gases from blast and other furnaces,

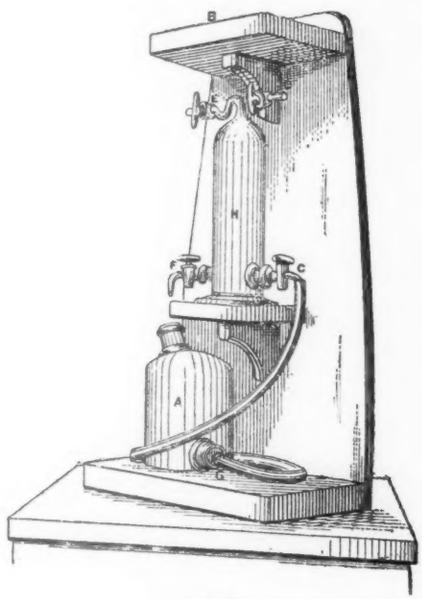


Fig. 2.

and that it was his intention that evening to exhibit and explain the apparatus, which had undergone considerable improvement since attention was first drawn to it. Dealing first with the sampling of gases, he said that with gases that are constantly changing in composition, such as furnace gases from solid fuel, it is impossible to obtain any average representative portion of the gas by simply drawing off a single pipette full by means of the old-fashioned pump. The old system used to be to take

off several samples at different times extending over a considerable period; to test each sample, and then to average the results obtained. M. Gruner had, he said, described a better method by which a large vessel filled with mercury, and having a tap both at the top and at the bottom, was used to collect the sample. The upper end was connected with the flue or other source of gas supply, and a receiver placed below. By opening both taps and adjusting the flow of mercury, regular portions of gas could be drawn in for a long period of time, and a fair average sample obtained in the vessel. He (the author) had designed a sampler on the same principle, also arranged to take the place of the old form of gas pipette. It was compact and portable, and could be enclosed in a case and left in any desired position; being self-acting when once started.

Mr. Stead's sampling vessel consists, as will be seen by Fig. 2, of a gas receiver *H*, and a mercury bottle *A*. The receiver is furnished with two cocks, *E* and *D*, at the top, for the admission or exit of gases; and with two others, *F* and *C*, at the bottom for mercury. The bottle *A* is connected to *C* and placed on the base *G*, when it is desired to draw in gas; or it is put on the upper shelf *B* when gas is to be sent out of *A*. The whole arrangement may be placed on the ground, or be hung on a wall.

In order to use it, *A* is filled with mercury and placed on the shelf *B*. The cocks *C* and *D* are then opened, and the mercury flows down into *H*, displacing the air. As soon as this is completely done the taps are closed and *A* removed to *G*. A connection with the gas supply is then made by means of the limb *E*. *E* and *D* are opened, and suction supplied to *D* by suitable means, until any air in the connections is completely displaced. When this is done *D* is closed, the neck of the bottle *A* placed under *F*, the latter opened, and the mercury allowed to flow into *A* at any desired speed. If the collection of the sample is to extend over any particular period of time, a graduated tube is used to receive the mercury from *F*. The contents of *H* being known, it is a simple matter to calculate whether the flow is too fast or too slow. If the sample is to be kept for some time before testing, the upper tubes must be filled with mercury, which can be done by inverting the apparatus and opening the taps for a moment. A portion of the sample can be readily passed into any burette, etc., by placing *A* on the upper shelf *B*, opening the tap *D*, so as to allow a sufficient quantity to escape to clear out the tube, and connecting directly to the apparatus. If a gas containing dust, etc., is to be examined the end of the tube inserted in the flue is covered with asbestos and the asbestos with copper wire gauze.

Where there is reason to suspect that currents exist in the flue, and that a sample drawn from one side would not present a fair average of the whole, a long slit tube extending across the middle of the flue (or, better still, two such tubes at right angles, the gas being drawn off at the center) is recommended. In operating on flue gases the entrance of air at cracks, loosely-fitting damper-frames, etc., must be carefully guarded against by plastering up all such openings with clay; and in all cases the intelligence of the operator must be directed to obtaining a fair average sample.

The original form of gas testing apparatus is shown in fig. 3, and comprises a graduated eudiometer tube *D*, the upper end of which is joined at right angles to the capillary tube carrying the taps *E* and *A*. Platinum wires are fixed into the upper part of *D* in the usual manner, for producing explosions by means of an electric spark. A tube *G*, exactly similar in size and length to *D*, is placed close by its side. This is closed at the top by a cap, through which passes a small tube *H*, open to the atmosphere. Both tubes are narrowed at the bottom, and connected by means of the branch pipe *I* to the mercury reservoir *C*, which can be raised or lowered to any desired position by means of the cord running on pulleys and the counterbalance weight, and is held in place by grooved perpendicular guides. There is a single laboratory vessel *F*, communicating with the eudiometer by means of the tube and tap *E*. A vessel containing water surrounds the tubes *D* and *G*; and, to secure accurate readings, a sliding spirit level, carrying a telescope, travels on two perpendicular bars in front of the tubes. The sample of gas is admitted to *D* through the tap *A*; and the laboratory vessel *F* may be charged with potash to absorb carbonic acid. The use of the tube *G* is to maintain a regular pressure in *D*. When the mercury in both tubes is at equal levels (as may be ascertained with the help of the spirit level), the contents of *D* are at atmospheric pressure. The water jackets guard against variations of temperature in the course of an experiment. A bichromate battery and Ruhmkorff coil are used to produce the spark.

This form of apparatus could only be used for absorbing carbonic acid and for ignition. For instance, a sample of chimney gas having been drawn in through *A*, measured, passed over into *F* to absorb the carbonic acid, and returned to *D*, a sufficient quantity of pure hydrogen could be drawn in at *A*, the mixed gases ignited, and the proportion of free oxygen present calculated by observing the diminution in bulk which followed the ignition. So a second form was devised, which only differed from the first by having three absorbing vessels *F*, each connected to the horizontal tube by an independent tap. But this has been displaced in favor of the arrangement shown in fig. 4. Six laboratory vessels, numbered *F*1 to *F*6, are arranged on a turntable, so that every one of them can be readily connected to the horizontal tube and tap *E* (fig. 3) by means of the device shown on a larger scale in fig. 5. The horizontal tube, and also each of the tubes attached to the vessels *F*1 to *F*6, are furnished with perfectly flat solid pieces of plate glass, perforated in the center, and firmly cemented to the ends of the tubes. The face of each plate being lightly smeared with olive oil, the horizontal tube can be readily connected with either of the laboratory vessels by means of the spring clamp shown in fig. 5.

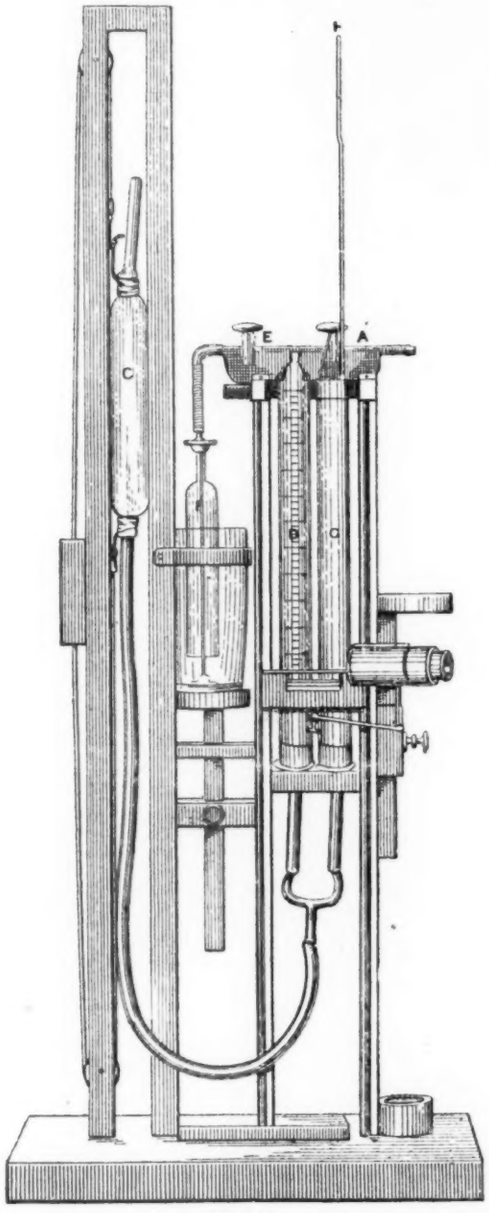


Fig. 3.

The latest form of Mr. Stead's gas analysis apparatus is well suited for the examination of coal gas, especially if the laboratory vessels are so designed as to protect their contents from contact with the air. It is somewhat complicated in character, and therefore rather costly. The turntable arrangement admits of adaptation to many other forms of gas burettes, and is a most ingenious device for allowing any desired number

of absorption vessels to be brought into contact with the gas-measuring tube. It lacks means for clearing out the capillary connecting tube; so that there would be a slight loss at each absorption, which could readily be estimated and allowed for. The laboratory vessels cannot be agitated

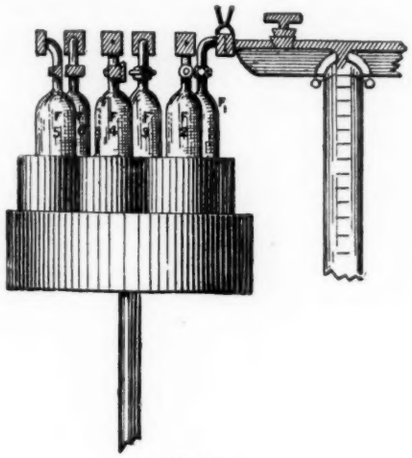


Fig. 4.

while charged with gas, and therefore more time is required for the absorption of some of the constituents; but when separate vessels are employed for each reagent, this can be remedied by charging them with

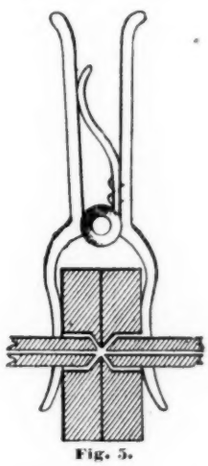


Fig. 5.

bundles of fine glass rods, or similar means for presenting a large surface, wetted with the reagent, to the gas. The glass plate and spring clamp arrangement, by means of which a gas-tight connection between the two tubes can be instantaneously effected, is also a very ingenious device, which is capable of application in connection with experimental gas apparatus generally.

How the Pennsylvania Railroad Company's Engineers Overcame Disaster.

The belief that all will be interested in a recital of the way in which the engineers of a great railroad speedily managed to repair an extraordinary chain of breaks in the system is our reason for reprinting the following condensed description of the work done on the Pennsylvania road in the matter of repairing the ravages consequent on the Conemaugh Valley disaster:

No one who has not seen the effect of the flood can at all appreciate the completeness of the devastation it effected in the districts involved, and when we consider also the suddeness of the disaster, the rapidity with which communication was re-established was indeed marvelous and, we believe, a feat without equal in the history of railroad work. The Pennsylvania Railroad Company may well be proud of the admirable staff of trained engineers and other employees who have charge of its property, and who have earned for it the credit of being, technically, the best managed road in the world.

The progress of the storm had been carefully watched for several days, and precautions had been taken, as far as human foresight could ordain, to prevent the loss of life and property in the territory under consideration. When the critical moment came, the floods in the east having reached their height, while those of the west, reinforced by the breaking of the South Fork dam, had acquired a momentum for destruction beyond the power of man to stay, all communication was broken, both by rail and wire, and concentrated action under the general direction of the superior officials was impossible.

In this extraordinary emergency each local official bestirred himself to heroic efforts to repair as rapidly as possible the damage to his own division, so as to establish a connection with that beyond.

In the east the executive offices of the company were moved to Broad street station, Philadelphia, and from that point a general supervision of the situation was exercised by the general officers, although, for the time being, little else than the securing and hastening forward of supplies to all the available points could be done. All the skilled workmen and carpenters from the eastern divisions were collected as rapidly as possible and forwarded to Harrisburg to be distributed north and as far west as the work on hand demanded. Bridge builders were contracted with and their entire forces were sent out on the line. Reserve workmen from every quarter were called into requisition, and the superintendents of divisions that had escaped severe damage were directed to send out all their available force and to secure all the help they could from other quarters. All the bridge lumber held in reserve at various points on the line was loaded on cars and forwarded or held subject to shipment to points where needed. In addition to this, the lumber dealers of Philadelphia, Wilmington, Baltimore and all accessible points were given *carte blanche* orders to load all the bridge lumber in their yards ready for movement at any moment. The same plan was pursued at every central point. The material collected in the East was shipped to Harrisburg and thence north and west to the first breaks in the line, which were respectively at Montgomery Bridge, on the Philadelphia and Erie Railroad, 20 miles south of Williamsport, and Granville, on the Middle Division of the main line.

At Altoona, a large reserve stock was always kept. That was forwarded eastward and westward for use at Manayunk and Mayes on the Middle, and the Viaduct on the Pittsburgh division. At Altoona, the surrounding territory from which to draw supplies was so limited by the washing out of the mills and the failure of rail connection, that little aid could be obtained outside the reserve stock, yet the work of collecting it, wherever available, went on with such rapidity as the nature of the case admitted.

At Pittsburgh, when all the local resources had been exhausted, the western lines were called upon, and they responded with men and material drawn from all points on the lines east of Cincinnati, Indianapolis, and Chicago. An enormous amount of material and a large number of men were forwarded from the West to Johnstown, reaching that point before the flood had receded enough for the work of repair to begin.

The principal effort was directed to the reopening of communication with the West. To this end a large force of men and carloads of material were dispatched at once to Sunbury for the purpose of rebuilding the Montgomery bridge over the Susquehanna, four spans of which had succumbed to the swift and swollen stream. They arrived at the scene of action without delay, but the condition of the river was such that the planting of trestles in the current was impossible. The flood subsided sufficiently by Tuesday, and within four days 400 men had bridged the river and re-established communication with the West, via the Philadelphia and Erie and the Allegheny Valley railroads. This achievement is one of the marked features of the recovery of the road from this disaster, as it opened a route to the Pittsburgh Division, and enabled the force from the Philadelphia and Erie to reinforce the work on the Pittsburgh Division with both men and material.

In the meantime operations had been commenced in the Juniata Valley on the Middle Division. A force of 700 men were detailed to forward supplies from Harrisburgh and mend the lesser breaks in the track, while 300 men were sent forward to rebuild the Granville bridge. This bridge, which was over 700 feet long, was not only washed away, but all the piers save one had been wrecked. Work was commenced without delay, and the site of the bridge was covered with a substantial trestling, 720 feet long and 50 feet high, in six days. With this bridge completed and the track leading to it repaired, an advance was made two miles farther west to Mayes bridge, and there in four days a trestling 780 feet long and 50 feet high was erected. The track along this entire section suffered severely. The ties and rails were not only swept away, but the ballast and foundation were carried with them. One section of some 1,500 feet of track, near Mayes bridge, was lifted from its

bed and deposited intact on end, in the mud, 100 feet away, giving the appearance of a stout picket fence.

While the Granville and Mayes bridges were being reconstructed, the work was proceeding with vigor on the Manayunk bridge. Peculiar difficulties beset the progress of repair at this point. The locality was cut off from communication with any large center of supplies, men were scarce, and the entire section having suffered great damage from the floods, it was not an easy matter to secure provisions for the workmen. Two hundred men were collected in the vicinity, and the task of closing up the gap was pressed forward in the face of all obstacles. Bridge lumber was obtained at Huntingdon, Tyrone and Altoona, and provisions for the workmen from the same quarter. Two or three miles of track had to be relaid on a new foundation, and with the small force laboring day and night, the work was finished, and nine days after the visitation of the most destructive flood ever known in the region, the three large bridges and seven miles of double-track road had been rebuilt.

West of Altoona, between South Fork and Johnstown, a distance of nine miles, the destruction was greater than on any other portion of the line, from the fact that to the force of the storm was added the violence of the flood from the broken reservoir.

The reservoir was located in the mountains nearly 1,700 feet above sea level, and 209 feet above the level of the valley, and about two miles to the southeast of the South Fork station. By the time the raging torrent had reached that point the force of the water had not only increased in power, but its destructive violence had been intensified by the accumulation of trees, stones, buildings and debris, which the mad flood had snatched up in its course. It swept down upon the village, carrying everything before it, and, as it roared and raged through the valley, it not only caught up in its watery embrace bridges and track, but in many instances carried away the ground on which the road was built. The South Fork bridge first met its approach, and, although it was not directly in the course of the torrent was demolished by the united water of the reservoir and the Conemaugh river. From this point to Johnstown bridge the road was almost entirely destroyed. Its condition was, indeed, appalling, and even if the means of restitution had been at hand, the experienced and skilled engineers of the Pennsylvania Railroad Company might well have stood aghast at the magnitude and difficulty of the task.

A large body of men from Altoona began to work westward from the South Fork bridge, while the local force at Pittsburgh, uniting with the large contingent from lines west of that point, undertook the herculean task of closing the gap between Johnstown bridge and Conemaugh bridge No. 6. The combined forces engaged in repairing this section of about nine miles amounted to 3,900 men, and the enormity of the work required their constant labor day and night.

The force working west from South Fork had some very difficult work to perform. Besides the rebuilding of the South Fork bridge, the replacing of the Conemaugh viaduct fell to their lot. This trestle bridge is undoubtedly a magnificent example of what may be called extemporaneous engineering. It is 400 feet long, 78 feet high, and is constructed on a curve. Solid heart timber is the material, and, although it was constructed in the most rapid manner, it is as firm and as steady as if made of stone. It spans a deep gorge, at the bottom of which flows the river, and on its northern side are the ruins of the magnificent arches of the old viaduct, their shattered masonry bearing mute but eloquent testimony of the violence of the flood. The road-bed west of the viaduct was also for the most part in ruins.

The next important feature in the rebuilding of the road is the trestle bridge over the Conemangh, known as No. 6. It is situated about half way between the viaduct and Conemaugh station. The river is wider at this point, and while the bridge, and its trestle approaches, is longer than the viaduct, it is not so high by 30 feet. This bridge is also a fine specimen of rapid bridge-building. It is constructed on quite a sharp curve, and the total length of the bridge and approaches is 600 feet.

A striking feat of skillful engineering is seen at Conemaugh. At this point the banks of the river rise up perpendicularly to the height of 1,000 feet. A shelf had been carved out of the mountain side on which to build the road-bed, and a curve in the river subjected this section of the track to the full force of the torrent. When the flood dashed against it about 1,500 feet of the track was not only carried away, but the ground and stone on which it was laid shared the same fate. The current of the river was changed so as to run where the track once rested, and in order to re-establish the line, trestling was put in or the entire distance and doubled so as to accommodate two tracks. This was, indeed, a daring undertaking, but it was accomplished with a skill and success which seem almost marvelous under the circumstances. From the eastern end of this trestle to the bridge at Johnstown the track, with a trifling exception, was built anew, a distance of three miles.

The roadway along this section was exposed to the full force of the water, and it was absolutely annihilated. Not only were the ties swept away and the rails bent and twisted into all manner of shapes, but the earth on which the road was built was carried off, and the track site so deeply covered in sand, gravel, and debris that the most experienced trackman could not with certainty locate the old bed. The entire work was finished and a solid line re-established in ten days.

Conemaugh station is at the western base of the Allegheny mountains. The town is built on high ground, inclining in a broad plain to the river. It was an imporant point to the Pennsylvania Railroad, as situated on this plain was a great freight yard and an immense roundhouse, where the heavy mountain climbing locomotives were stored, and attached to the freight trains to aid them in ascending the mountains. The flood swept over this yard with such mighty force that every vestige of a building was swept from the face of the earth. The great brick and stone roundhouse, containing 35 engines, succumbed, and the work of destruction was so complete that the foundations of the roundhouse cannot be traced. The 60-ton locomotives were dashed away like chips on the relentless current, and left in various places imbedded in sand and debris.

Every conceivable obstruction presented itself—the lack of facilities of communication so as to concentrate material and laborers at desired points, the scarcity of material in certain quarters, and, above all, the inability to commence work on account of the high water and the incessant rain. There was not an entire fair day during the progress of the work of repairing, but, on the contrary, a ceaseless downpour of rain fell in the western part of the State throughout the week succeeding the flood.

The subsistence of the 1,500 men at work on the line was a question of the utmost importance. The food had to be brought to them from distant points, and they had to be sheltered on the ground. Long trains of cars arranged for sleeping purposes were disposed at convenient places on side tracks, while at other points camps were pitched, where the men ate and slept. There was little sleep for them, and, in many instances, gangs of workmen labored without relief for 24 hours. Electricity was used for facilitating the night work, and the sound of hammer and saw reverberated through the mountain valleys at midnight as well as midday.

Thus by ceaseless labor, marvelous energy, wonderful skill, an utter sacrifice of personal comfort on the part of engineers and workmen, the greatest work of the age was achieved, with brilliant success, and the Pennsylvania Railroad recovered from a blow which would have paralyzed the energies of any other railroad in the world.

[Read at the late Meeting of the British Gas Institute.]

Gas Purifiers.

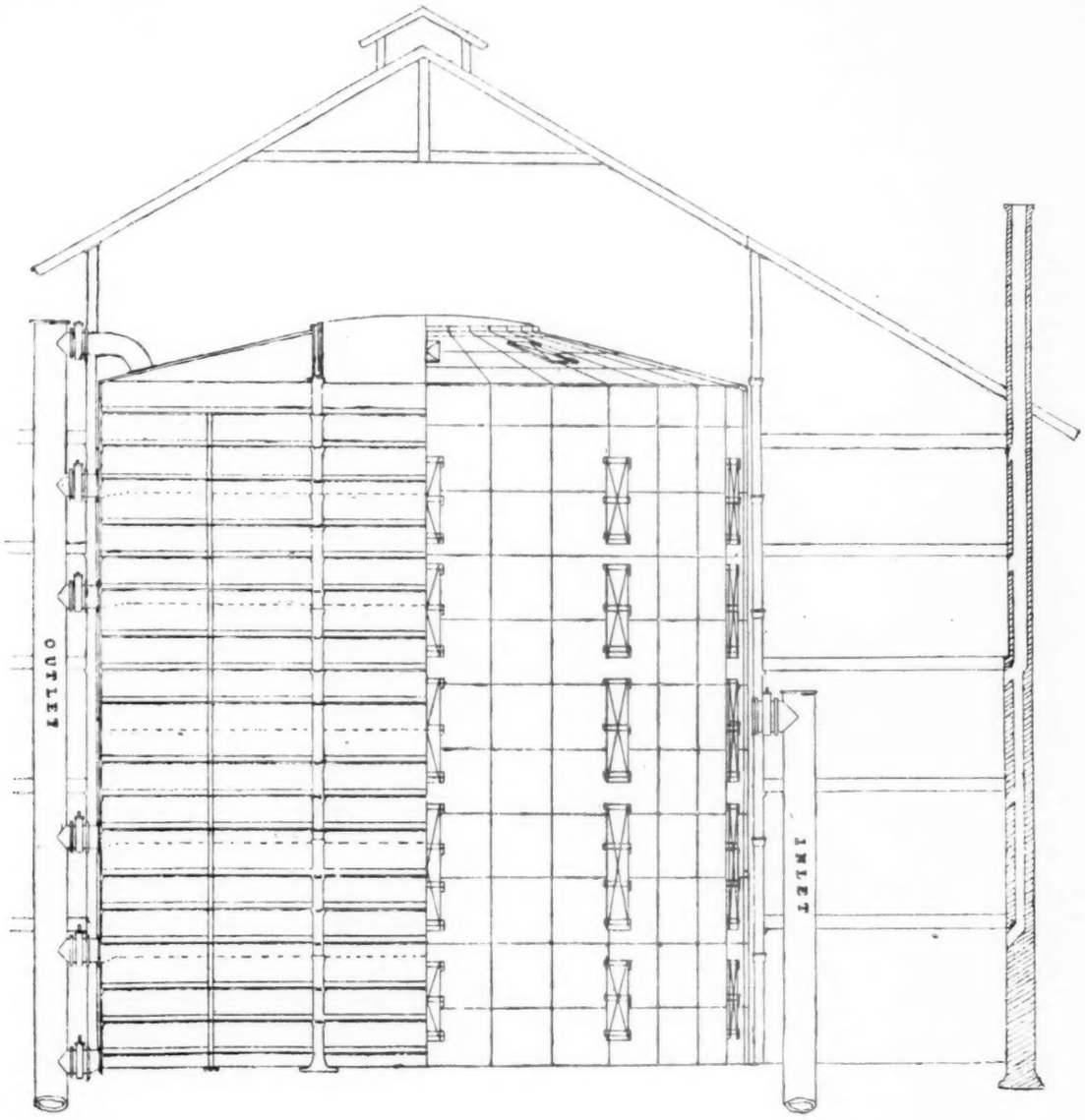
By Geo. Anderson, C.E.

The mode of constructing and working purifiers which forms the subject of this paper was included in my patent of 1875, No. 2,843. It may be remembered that about and just before that time there was considerable cry about sulphur in gas; and the London companies and the gas referees were much taken up with that question, which also included that of nuisance from lime, by which, could they but use it, the companies could have abated the quantity of sulphur remaining in the gas.

At works under my care I did purify with lime, producing very little smell, and being engaged on the inquiry that took place at that time, I had to inquire into the then state of things. This inquiry brought out the fact that in most of the works the purifiers were decidedly too small. Gas was passing through the purifying material at the rate of from 5,000 to 6,000 cubic feet per foot of surface per 24 hours; whereas in my works it did not reach 2,000 cubic feet. One engineer told me that in winter the rush of gas lifted the lime off the trays. One could see in an instant that satisfactory work could not be done under such circumstances; nor until large purifiers were provided, for which there was very little space. It occurred to me that the purifiers might be deepened, and the area doubled on the same space, by dividing the stream of gas into two—one entering at top, the other at bottom—both meeting in the middle. The drawing on the wall (see illustration) shows what I mean. It represents a purifier, 50 feet in diameter by 60 feet high, which would contain over 70,000 cubic feet of oxide, divided into six parts of three layers each. The gas would be divided into two streams—one entering at bottom, the other at top—and passing on to the middle it would pass

off at the outlet. When the upper three and the lower three layers became thoroughly fouled, the second valve from the top and the second from the bottom would be opened; and when these became fouled, then the third from the bottom and the third from the top would be opened. Of course, the principle need not be carried so far as into the three divisions described; it might be limited to one valve below and one above, which would require the purifier to be cleaned out oftener, but would still purify double the gas now done on the same area.

A purifier of the size I have described would only be suitable for the very largest class of works, but the principle may be applied to purifiers of any desired smaller size.



In working purifiers of the size I have described, both the charging and the discharging of them would involve variation from the present mode. The purifier might stand in a house wide enough to include the revivifying ground—containing a number of floors, with ventilating shafts in the thickness of the wall to carry up all effluvia to the top of the house—and faced doors could be fixed on the side of the purifier, through which to receive and discharge the purifying material; or the foul material might be hoisted up through the center by a steam crane, tipped into wagons, and distributed over the floors, falling from one to another, till ready for charging into the purifiers, when it could be hoisted into them. When the purifiers are very large, the movable lid need not be more than 15 to 20 feet across The rest of the top may be the same strength as the sides, and may be flat or raised, as shown. In very large purifiers the internal construction for supporting the trays could be arranged so that a great portion of the trays and supports would remain in—only removing enough to give the men room to work. On the drawing shown, the lid water-lute is shown resting on a circle of columns, which would support the girders and form supports for the trays; but I need not incumber the paper with mechanical details, which practical men could arrange for themselves in the way most suitable to their local circumstances. What I wish to impress on you is the purifying of double the quantity of gas now purified on a given area.

The question then arises, what is now done by purifiers of the usual kind, and what, by parity of reasoning, could be done by those I have described? At a works of which I am engineer we make a little over 200,000,000 cubic feet per annum. We have six purifiers, 36 feet by 18 feet by 6 feet—two of them for lime and four for oxide. I wrote to the manager as to the number of purifiers charged per annum, and the cubical contents of oxide put into each. His answer was: "In the year 1888 we made 208,831,000 cubic feet of gas. To purify this six charges of oxide were required, each of which contained 2,430 cubic feet of oxide. The total, therefore, was 14,580 cubic feet of oxide."

I will now apply these figures to one of my purifiers, 50 feet diameter, divided in height into six compartments of oxide of three layers, each 2 feet in thickness. Cubical contents of oxide 70,686 feet—hence, 14,580 : 208,831 : 70,686 : 1,012,443,000 cubic feet.

Were the purifier reduced by one-third of its height, that is, each stream of gas passing through only 12 feet in depth, the quantity purified would be lessened to 675,962,000 cubic feet; or were the purifier reduced to one-third of its depth—that is, the lower inlet passing up through 6 feet of oxide, and the upper inlet passing down through 6 feet of oxide,

the quantity would be still further reduced to 337,481,000 cubic feet. But if the purifier were to be reduced to only two compartments, as last mentioned, I think that each compartment might contain 8 feet in depth of oxide, which would increase the last fignre to 449,974,000 cubic feet.

Where the purifiers were of the depth first mentioned—that is, the gas passing up through 18 feet of oxide from the bottom, and down through 18 feet of oxide from the top, I would say that two such purifiers would suffice, because the first, or foulest, need not be charged till you had a foul test when the gas had passed through one-third in depth of the second.

That more gas can be purified on the same ground surface by the way I propose is self-evident.

So much as I have stated depends on the correctness of the figures of a year's working which I received from the resident engineer of the works to which I have referred. I should state that in the works referred to the gas is first passed through one of my washers, 24 feet long by 12 feet broad, next through a vertical scrubber, 15 feet diameter by about 25 feet high, and next through one of my five-brush scrubbers, each brush 10 feet long by 4 feet diameter. The whole of the ammonia and much of the carbonic acid and sulphureted hydrogen are removed from the gas before it enters the purifiers; and we also use Hill's process of introducing a percentage of air into the crude gas before the condenser.

The purifiers I have described are so different from those in common use that I am prepared for the dissent of gentlemen without feeling the slightest offense; but my defense is, while improvements have been made in almost every part of our apparatus, our purifiers remain the same as they were fifty years ago. They have only augmented in size as consumption extended, and they are mere enlarged copies of their originals. When purifiers were first made they were only 3 or 4 feet square, and the lids were of the full size of the purifiers; they have grown to be 20 to 30 feet square; the lids are of the same size, and have become so heavy that some ingenuity has been brought to bear on the best means of lifting them. While gas was sent into the purifiers loaded with strong-smelling impurities, there was some reason for having the lids as large as possible; but as that is now abolished in well-managed gas works, the size of the lids, as well as the depth of the purifiers, may be varied without injury to the men.

Members of the Institute of 20 years' standing may remember that I have been an advocate of large purifying surface, and our Transactions prove this [Transactions, 1874, pp. 51–66]. I am of the same opinion still; and I now suggest a mode by which their effective area may be increased without enlarging the area on which they stand.

I would not close this paper without drawing the attention of members to the valuable work being carried out by Mr. Valon, of Ramsgate. Mr. Valon is purifying gas by a mode by which the material lasts much longer, and is almost void of offensive smell when removed from the purifiers. I trust that some of the members in charge of large works may be inclined to follow on the same lines, and, I hope, obtain equally favorable results.

Discussion.

Mr. W. W. Hutchinson wished to bear his testimony to the cool and kindly way in which Mr. Anderson had introduced his subjects to the members, so that whether they were the representatives of large or small works, the papers might be discussed in good fellowship and with kindly feelings.

Mr. D. Clarke wished to ask if the author of the paper found any increase of pressure from the process. There was also a paragraph about the lids which he did not quite understand and which he would like explained.

Mr. T. Travers, Cork, who was invited to address the meeting, said he was quite unprepared to say anything on the matter. He did not intend to make any remarks at all. On his side of the water they had had the experience to which Mr. Anderson referred, and it was a very satisfactory experience, and he might add that it might be attributed in a great measure to the system by which they injected air into the purifiers. There had been a great deal spoken on the previous day about illuminating power. Their experience was this, that very few injected the air regularly, as they did. Every hour they took the make of gas from a station meter, and they also took the quantity of air accurately, and saw that it was properly proportioned—that was to say, that no more was injected at one period than another. To this circumstance they attributed the duration of their purifiers. In January last, he thought, they changed the purifier. They found that the oxide, some two or three years ago, contained 60 per cent. of sulphur. That was from an experiment made in the summer, and they worked it with a proper quantity of air. In the winter time he put in oxide with 47 and 48 per cent., and worked it with a proper quantity of air, and it had continued up to the present time. Such was their experience of purifiers, and they were perfectly well satisfied; and they, in a great measure, carried out the theory that Mr. Anderson had enunciated that day.

The President said he would like publicly to thank Mr. Anderson for the efforts which he had put forward from time to time in regard to purification. He, himself, on his own works at Ryde, and at other works with which he had been connected, had been under a debt of gratitude to Mr. Anderson for the energetic way in which he had put forward his ideas in years gone by, both with regard to the large quantity of oxide used, and especially with regard to the thickness and the character of the lime. When he (the speaker) first adopted the purifier in accordance with Mr. Anderson's idea, and mixed up the lime like a mortar, instead of finding the pressure increased he discovered that the water was taken out of the greater portion of the interstices and it became a spongy mass. Since he took Mr. Anderson's ideas he had had no difficulty—the pressure did not rise if the purifiers were loaded in a proper way. Pressure was a matter which they had not to look after. He simply rose to say that much out of a debt of gratitude—or rather of justice to their old friend and to let him know that his work had not been labor in vain.

Mr. Anderson, in reply, said that the first question that he had been asked was, did he find under that mode any increase of pressure. He must tell them that, although he took out the patent eight years ago, he had not pushed it. He had simply patented it with a number of other things, in case some other body should be doing something of the same kind and taking the wind out of his sails. He had, therefore, no experience of passing gas through a purifier with that amount of oxide in it. He had not proposed that, however, without having considered the matter. He had taken the pressure at the inlet of the first purifier, and at the outlet of the fourth, and there were about 3 feet 6 inches of oxide in each purifier, and the difference he had found between the first and last was about 2 inches. Of course, that would vary with the quantity of gas passed; but there, at any rate, he had 12 and 14 feet. He had another experience, and if Mr. John Somerville was in the room that gentleman would confirm it. Mr. Somerville did a wise thing some years ago. When he was an engineer at Dublin there was a gasholder there in little use, in consequence of the magnificent works erected there. He had an iron tank some 15 feet above the ground and a few feet below; it was disused as a gasholder and he used it as an oxide purifier. He filled it with some 15 feet of oxide. Mr. Somerville found then that when he first charged the purifier he could get the gas to pass easily enough. There was no trouble about pressure. That was when the oxide was clean, but when it got foul the pressure increased so enormously that it became impossible to pass the gas through it. It raised the pressure from about 7 inches up to 6 or 7 feet, and it really had to be taken out of the purifier before it was exhausted. He (the speaker) having that information in his mind, thought that to pass the gas down through 18 feet of oxide would not be too much when it was clean. When it got foul he had the means of letting it in again lower down, until the whole was expended and the purifier had to be cleaned. But he would not advise any of his hearers to begin at that large depth at once. He was quite confident that anyone confined for purifying space might put up a double purifier, one coming in at the top and the other at the bottom. There was no difficulty about that. By that method he would at least double his purifying service. He was asked another question about the lids. They could not cover the vessel unless it was the same size. In those hurried matters they could not conceive everything at first. The top purifier formed part of the permanent body of the vessel, and the lid was only that portion of it which they saw open, which was some 14 or 15 feet, or 20 feet, as they might like. With very large purifiers there was a considerable difficulty in lifting the lids without a great many mechanical appliances, and as he did not think there was any necessity for their being of the same size as the purifier he had curtailed it so much, on the same principle that they did not open up the side of a house for the purpose of getting into a room when a door would answer the purpose. Mr. Travers said that he found no difficulty in the illuminating power. He (the speaker) believed that that was because Mr. Travers was very careful. He had two jets burning constantly before the man who had charge of the engines. Those jets were regulated to burn, with the same height of flame, the gas made and the gas sent out to the public. Therefore, if anything took place, such as too much air, down went the height of the flame, which was in an instant noticed. He might state that Mr. Travers was under very critical and strict supervision. His gas was tested by the Corporation tester, and if anything was to go wrong he would find it out to his disadvantage. He (the speaker) was

happy to say that the gas had never been found fault with, although, perhaps, it might sometimes be half a candle above or below the standard of the Corporation tester. Mr. Travers mentioned something also with regard to the injection of air. There were a number of people, he saw from the discussions that were going on, who were trying that. Now, they might do that successfully and they might do it unsuccessfully; it depended a great deal upon how they went about it. More than 20 years ago, when he was at the Dover gas works, he had a very intelligent manager there—a man with a mechanical mind, and who had been, in fact, a mechanic—and it very often happened that they succeeded or failed according to the man they got to carry out the thing they wanted. That man simply put a 1½-inch hole in his horizontal condenser, and screwed a little valve into that, which was faced below; and every slight oscillation of the exhauster brought in a little air at each revolution. He at first found some difficulty; sometimes he got a little too much air for the illuminating power of his gas; but with a little practice he soon got it to do the work thoroughly, and it required very little attention. That was a mode which he (the speaker) would not advise anyone to try who could not look carefully after it. Another mode had been to pass the air through a meter and into the gas. Well, if they were not pumping their gas over and over again, as they sometimes did when they opened the bye-pass valve—if they passed it in with a constant quantity, they might be putting in more than they ought to do, because they would be pumping all that over and over again. That was another difficulty which they must guard against in putting it in in that way, automatically. Now, Mr. Travers had got an excellent way. He put up a very small gas engine and steam pump—a thing which, on a plan, occupied as much space as one of those small tables—and the pump was worked in the presence, and under the control, of the man who worked the exhausters, and he saw every hour whether it was doing too much or too little; and by having the statistics constantly before him, he was not likely to make much mistake. Their friend, the President, referred to his having done better with his purifiers when he used his lime wetter than he was in the habit of doing previously. When he (the speaker) began to do anything with the gas he looked into the best authorities on the subject. Clegg's book was the first he had; it was the first edition. He was told there that the lime should be made so wet that if they took up a handful and squeezed it it would remain in position and would not fall to dust. He believed that a great many men did that more or less at the present day; but he had formed the opinion that to purify gas they must have humidity, and the more humidity they could have so much the better. He used his lime so wet that it was almost in little balls of about the size of a walnut down to a pea—not in dust at all, but in small nodules or particles; and although they were in the habit of putting their lime in from 12 to 13 inches thick in their purifiers, he had never found that the center lime was not as well worked off as the outside lime was. By doing that they got from double to treble the quantity of gas purified that they would get if they were to have the lime in a dry state. He warned them against being guided by what they read in books. There was a great deal said in writing by men who were simply writers, and did not understand much about what they were saying. He would advise them always to take everything that was said in that way with a little grain of salt, and try themselves to find the matter out. Mr. Travers was doing a very good thing. He put a small portion of lime with his oxide, and possibly if they did that they would be able to get their oxide into the same condition as they got their lime when they wetted it. Instead of the lime going into one homogeneous mass, they would get it put in nodules, as he said; and if they had only so much lime as to cause a little adhesion, they might get their oxide to give much less pressure than it now did. He was very much pleased if anything he had ever said or done had been of the slightest advantage to any member of the Institute. He had always worked for the benefit of the Institute, and had always felt it his duty to do what was required at the proper time, and get out of the difficulty as soon as he could. He hoped always to continue in the same way, in giving as much information as he could.

LAST month Mr. Albert D. Perry, who for some time back had been in charge of the electric lighting department of the Pawtucket (R. I.) Gas Company, resigned that position to accept service with the Thomson-Houston Company, at Lynn, Mass. His departure was made the occasion, by the employees of the electric light station, to signalize their appreciation of his method of managing them. Their testimony to his capacity took the shape of the gift of a handsome umbrella, the handle of which is of the glittering sort. The presentation was made by the Collector, Wm. McGregor, and Mr. Perry thanked his associates in a most appropriate speech.

History of a Heap of Oxide.

By NORTON H. HUMPHRYS, F.C.S.

[Amongst the papers read at the late meeting of the British Gas Institute, was the following, on the above subject, by our English correspondent, Mr. Norton H. Humphrys.]

I may at once preface this paper by disclaiming the idea of having any novel or striking points to bring before the meeting, or anything beyond a plain story of gas works every-day life. In the abstract, it is usually admitted that one of the chief objects in view in the reading and discussion of papers is that of comparing our experiences; but, as a matter of fact, members refrain from doing so, unless they have hit upon some new line, enabling them to set forth results that surpass those hitherto obtained in our ranks. To hear and to tell of some new thing appears to be the chief end in view; and, consequently, many of our members sit silently in their seats, year after year, simply from an apprehension that their experiences possess no striking hue of novelty. Without detracting in the slightest degree from the importance of a knowledge as to the latest developments in our profession, I cannot but think that it is also desirable for us to possess a more intimate acquaintance with the details of every-day working. In the hope of contributing to a small extent in this direction, I have ventured to trespass on your time with a plain account of a heap of oxide, and the work that it has done, in the way of removing sulphureted hydrogen, at the Salisbury gas works.

The usual way of estimating the work done by purifying materials is to state the quantity of gas purified by them. If the proportion of impurities remaining at the inlet to the purifiers, to be removed from the gas, was a fixed and definite quantity, this plan would be accurate; but such is not the case. As a general rule, the whole of the condensing, washing and scrubbing plant remains in use throughout the year, regardless of the fact that the make of gas during the summer months is only one-third or so of that in the winter. My range of gas made per diem throughout the year is 320,000 cubic feet on the one hand, and 100,000 on the other. Now, the 100,000 cubic feet gets as much condensing, washing and scrubbing as the 320,000. The only difference is that the scrubber pumps are not running so fast in the summer as in the winter. The natural result is that in the winter the impurities pass *further forward* than in the summer; and as regards the particular one under consideration—sulphureted hydrogen—it ranges from 600 grains per 100 cubic feet in the winter, to 440 in the summer. The sulphureted hydrogen line possesses a marked similarity to that of the make of gas, but is also influenced by other causes, atmospheric temperature being an important one. During the winter, and also during the summer, it is fairly constant, but subject to fluctuations during the spring and autumn.

On account of this fluctuation, the quantity of gas purified furnishes only a very approximate estimate of the work done by the material. Just in the winter, when conditions are less favorable, it may have 600 grains of sulphureted hydrogen to deal with; and in the summer, when the make is so much less, only about 70 per cent. of that quantity. An extended series of experiments is therefore necessary before anything like a definite conclusion can be arrived at as to the quantity of sulphureted hydrogen to be removed in the purifiers in the course of a year. From the results of some 70 different tests, including at least one in each week, taken during the year 1888, it appears that the total weight of sulphureted hydrogen present in the gas, and removed during the year, was 23 tons. This represents in bulk 573,350 cubic feet. The quantity of gas made was 69,000,000. Therefore the average is 522 grains per 100 cubic feet, or 0.831 per cent. by volume.

The heap of oxide, which is the subject of our attention, was delivered at the works some 3½ years ago. It consists of a natural clay-iron ore, as found on the ground surface at Westbury, Wilts; and is simply prepared by drying and crushing. In this state it is supplied to most of the gas works in the neighborhood. It has been my duty, on several occasions, to analyse samples of this ore, and the composition of this particular sample was accurately ascertained. For the present purpose its composition may be taken as 66 per cent. hydrated peroxide of iron; 28 of earthy matter; and 6 of uncombined water. In accordance with the usual plan of dealing with this kind of oxide, it was prepared after delivery at the gas works by mixing with about its own bulk of sawdust. The weight of the oxide was 20 tons; and 4 tons weight of sawdust, together with about 15 per cent. of water, were used in preparing the material. Its composition, when ready for use, was as follows:

	Cwts.	Per Cent.
Hydrated peroxide of iron	264	49
Earthy matter	112	21
Organic matter	80	15
Water matter	80	15

As compared with the best Irish bog ore, this sample is very rich in iron; but the presence of so large a proportion of earthy matter would be regarded by many as an objection, as likely to cause back pressure. With ordinary care, and purifiers of ample area, no trouble arises from this cause; but where the purifiers are comparatively small, Irish ore is preferable. A box 20 feet square, fully charged, gives about 0.4-inch back pressure. The Westbury is very much cheaper than Irish ore. The cost of the heap ready prepared, as above mentioned, inclusive of sawdust and labor, was not more than 13s. 4d. per ton.

In order to avoid the complication due to the presence of various proportions of moisture in the several samples of this oxide, it was tested for moisture under the conditions usual in testing oxide, by exposure to a temperature not exceeding 200° Fahr., until it ceased to lose weight. The sawdust used was found to contain 45 per cent. of water. By this means a "dry basis" was arrived at, for use in calculations based on the sulphur test. On this dry basis the material weighed 21 tons, as follows:

	Cwts.	Per Cent.
Hydrated peroxide of iron	264	63
Earthy matter	112	26½
Organic do	44	10½
	420	

Considerable disadvantage was caused by the fact that it was not practical to commence *de novo* with an entirely new stock of oxide. This heap was used in conjunction with three others, two of which were nearly spent; and it was thereby placed in the position of being yoked in as one of a lame team, and forced to do more than a fair share of the work. Indeed, it was unfairly prejudiced by the endeavor to get as much work out of the old stuff as possible before rejecting it. The purifiers in which the oxide is used are 20 feet square, and two in number. There are also four purifiers, each 12 feet square. The two large boxes are used for oxide, two or three of the others are charged with lime, and the remainder used as check purifiers, and filled with oxide. The arrangement of valves permits either the two 20 feet or the four 12 feet to be used first; but the usual way of working is to apply the 20 feet first, so that they practically take out all the sulphureted hydrogen. They are worked together, until a foul test shows at the outlet of the second. The first is then changed, the check purifier being meanwhile depended upon to take out the small proportion of sulphureted hydrogen that passes the large purifier. As the make of gas varies from 100,000 to 300,000 cubic feet per diem, the horizontal area of purifying surface ranges from 4 to 1.3 square feet of surface, or horizontal area, per 1,000 cubic feet of gas.

It was hoped that by starting with a rather small allowance, as compared with the size of the purifier, the whole heap might be maintained in operation together until quite spent; but at the conclusion of the eighth exposure it had increased in bulk so much that this could not be carried out. One-fourth of the whole was therefore removed, in order that no further alteration need be made. During the first four exposures the material acted well, doing more than its fair share of the work; but at the fifth exposure we came to grief. In accordance with a suggestion made to the writer, it was put in the purifier in one thick layer, instead of in two, which is the regular custom. The result was that the purifier had to be turned off, on account of back pressure, before it had got well into work. The disproportionately small percentage of sulphur removed in this experiment may perhaps attract attention. A consideration of the method of working as above stated furnishes the explanation. Since the purifier, for some time after being started, forms the second in the series, the first box was doing the greater part of the work. After this a fair start was secured in the sixth exposure; but a little falling off showed itself in the seventh; and the eighth was brought to an abrupt conclusion on account of back pressure. The cause of this has been already pointed out.

No. of Exposure.	Cubic feet of gas passed.	Days in use.	Interval of rest.	Soluble in CS_2 Per cent.	Cwt. Oxide.	Cwt. H_2S.	H_2S, according to Soluble S.	Total H_2S.
1	8,600,000	58	37	9	420	44½	..	
2	12,030,000	43	32	16	"	40¾	85½	
3	11,550,000	59	79	25	"	63¼	148½	
4	14,000,000	74	43	33⅓	"	74½	223	
5	7,400,000	28	49	34	"	6¾	229¾	
6	15,500,000	91	124	38	"	44¾	274½	
7	11,850,000	53	37	41½	"	42	316½	
8	7,350,000	28	24	42½	"	12¾	329¼	?
9	32,270,000	224	70	52½	315	122½	369½	
10	5,880,000	21	38	54	"	23	382½	
11	10,350,000	49	"	56	"	33	415½	432
	136,780,000	728						

We now come to the ninth exposure, which is interesting as showing the advantage of admitting a very small percentage of air at the inlet of the exhauster. At the commencement of this exposure, the use of air was very cautiously begun. After a time sulphureted hydrogen made its appearance at the outlet, and the air supply was gradually increased until this disappeared. A little under 1.5 per cent. was necessary to secure this result. It was admitted through a 30-light wet meter at the inlet to the exhauster, which was run at $\frac{5}{10}$ vacuum. This was sufficient to draw air through the meter. The actual quantity of sulphureted hydrogen was about 0.7 per cent.; and since one-half its volume of oxygen is needed to secure complete revivification, it follows that the proportion of air shown by theory to be needed is 1.75 per cent. The difference between this and the quantity actually admitted was probably furnished by the small quantity of oxygen that is always present in the gas from various causes. However this may be, sulphureted hydrogen did not again appear until the make, and also the proportion of impurity to be dealt with, had increased so much as to reduce the proportion of air to 1 per cent. The meter and connection was then being worked to its full capacity, and therefore more air could not be admitted. As soon as the sulphureted hydrogen showed a determination to increase, it was considered advisable to close this experiment, which was done after the box had been 224 days in use, removing the whole of the sulphureted hydrogen during the greater part of the time.

The tenth exposure was a short one; but this was no fault of the material. The oxide in the other box failed on account of being saturated with sulphur. In both the tenth and eleventh exposures the admission of air was continued to the extent of 1 per cent. or less, but did not appear to be of much use. I do not think that the oxide is failing, because other heaps of similar material have been worked up to 63 per cent. of sulphur, but am rather inclined to ascribe it to the fact that the material came out after the long exposure quite its natural color, and very dry, containing only about 5 per cent. of water. From this I conclude that the material had become warm while in use. It was wanted again after 40 days, and did not receive a fair share of turning and watering. Now that the summer has come, we are able to give it a long rest, and also extra attention, so that the next exposure will reveal the true cause.

Attention may now be directed to a singular point in connection with the ninth exposure. Looking at the working during the previous exposures, and taking all the circumstances into consideration, the quantity of sulphureted hydrogen removed, as calculated from the results of the bisulphide of carbon test, appears to be satisfactory; but in the ninth exposure there is a deficiency between the results of the bisulphide test, and those computed. The former shows 122½ cwts. of sulphureted hydrogen, and the latter about 140 cwts. On examining the residue after treatment with bisulphide, it was found that a considerable proportion of sulphur remained in an insoluble form, and this sulphur came in the first place from the sulphureted hydrogen in the gas; so it is evident that in this case the bisulphide test failed to indicate the whole of the sulphur present. A sample of the material was thoroughly washed with bisulphide of carbon, until the liquid ran off perfectly colorless, and left no residue on evaporation. One portion of this sample was thoroughly oxidized, and another was fused with bicarbonate of soda, the sulphuric acid being precipitated in each case as sulphate of barium. By this means it was ascertained that, in addition to the sulphur soluble in bisulphide of carbon, some 16½ cwts. was present in the heap in an insoluble form. I do not propose to attempt any explanation of the way in which this insoluble sulphur is combined, but should be glad to hear whether similar results have been observed in other cases with oxide that has been revivified *in situ*.

On comparing the practical results shown with those indicated by chemical theory, it appears that a large proportion of the hydrated peroxide of iron is inactive, or for some reason or other does not come into operation. It is generally accepted that one equivalent of hydrated peroxide enters into combination with three of sulphureted hydrogen. Assuming this to be correct, this heap of material should absorb 126 cwts. of sulphureted hydrogen before it is completely saturated. In no case was this obtained without the use of air. Leaving out number 9, the highest result is No. 4, where nearly 60 per cent. of the theoretical duty was obtained. In other cases only about 33 per cent. was realized. Considering that even when oxygen is not designedly admitted, there will always be a certain amount of revivification *in situ* going on, a nearer approach to theory might be expected. But it is important to remember that in ordinary working the purifier does not remain in use till it is saturated and will not do any more work. The time for turning off is ascertained, not by testing the gas at the inlet and outlet respectively to see if any important proportion of the sulphureted hydrogen is still being removed, but by the fact that the next box shows a foul test. This

usually obtains when the first box is still doing the greater part of the work, and removing more than 300 grains of sulphureted hydrogen per 100 cubic feet. So the oxide is under very different circumstances ftom those of a laboratory experiment, where an excess of sulphureted hydrogen is passed through it until no more is taken up. It is also to be expected that the results, with such very dilute mixtures of sulphureted hydrogen as those which obtain with foul gas, would be different from those that take place when pure sulphureted hydrogen is used. In the second purifier the oxide has to deal with not more than 1 or 2 parts per 1,000 of sulphureted hydrogen. The tests obtained at the outlet of the first purifier furnished an important indication of the value of the material to the gasmaker, who requires an oxide that will not only deal actively with the comparatively large proportion of sulphureted hydrogen in the first purifier, but be equally energetic in removing the tailings in the second.

The history of this heap of oxide is not yet closed. At present it is undergoing a long rest, as the purification is being conducted with some newer oxide and the use of air; and I do not expect to change a purifier before October. There is no reason why as much should not be done with it as with other cargoes of similar material. In that case it will serve for about five more exposures, or a less number if air or oxygen is used, and it will gain up to 63 per cent. of sulphur. I may mention that in the last lot of new oxide received, the proportion of sawdust is increased twofold, and, so far as can be seen, with satisfactory results. The proportion of pure oxide in the heap under consideration greatly exceeds that present in Irish bog ore, so the Westbury oxide might be diluted to a much greater extent, without being rendered poor in iron. This suggests whether it might not be possible to hit upon a material more suitable than sawdust for diluting the oxide. Even the hardest sawdust seems to soften and rot under the influence of repeated exposures and revivifications, and the buyers of spent object to a large proportion of sawdust, as likely to injure the color of the acid. We want something as light and porous as sawdust, but tougher and more of a fibrous nature.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

A CORRESPONDENT advises us that the gas and electric lighting interests of Red Bluff (Cal.) have been consolidated. The title of the new corporation is that of the Red Bluff Electric Light and Gas Company, with a capital stock of $100,000. J. S. Cone is President, and Mr. L. C. Grapner is Secretary and General Manager.

SOME months ago a syndicate of Philadelphia capitalists, as the result of a thorough investigation of the value and merits of the properties examined, agreed to purchase the Independence (Mo.) gas works, water works, and electric light plant—these properties are all virtually under one management—payment in full for the same to be made on July 1. The syndicate having failed to complete its purchase within the specified time, the Directors of the Gas Company instructed Superintendent Wirt to make immediate arrangements for the enlargement of the works. It was also agreed upon that an investigation of the different water gas processes be made, with a view to determining whether gas could be manufactured more cheaply than by the coal process at present employed. The ruling net selling rate at Independence is $2 per 1,000 cubic feet.

THE East St. Louis (Mo.) Gas Company has been awarded the contract for equipping the newly erected school buildings—which, by-the-way, are a credit to the place—with gas fixtures.

THE Committee on Legislation of the St. Louis Council have almost perfected the draft of the bill under which it is proposed to regulate the price of gas in that city on and after 1890. Would it not be well for the St. Louis solons to await the developments that are sure to come from the change in ownership of the gas properties of their city? As we seem to see it, the present management can be counted on to sell gas at the lowest possible figure.

AT the last regular monthly meeting of the Selectmen of Chicopee, Mass., it was most sensibly resolved to discontinue the primitive method—heretofore followed—of lighting the bridges spanning the Chicopee river by means of kerosene *lanterns*. Gas lamps are to be maintained.

FOR the last four months the authorities of Galena, Ills., have had "under probation" a sample of incandescence electric light illumination for the streets and public buildings. When (on the evening of the 3d inst.) the City Council met to determine whether or not the city should accept the system as satisfactory, it was voted to reject the same, on the ground that "the service was imperfect, and very much inferior to what it was represented to be." There cannot be great room for doubting the fact that incandescence electric lighting will never fill the bill as a street illuminator.

AN odd and shocking accident is reported from Cincinnati, Ohio. Jas. Kane and several other laborers were engaged in digging a trench for a line of pipe in connection with the Cincinnati Gas Company's main system. The men were at work in a very close line, and Kane's follower, who was wielding a pick, slipped while the pick was high in the air. The iron, in descending, struck Kane in the back, inflicting a serious and painful wound. Such accidents, which are all too common, should never occur; and they would not occur, if the foremen kept their work well in hand. Placing men in trenches about as closely as peas in a pod does not by any means indicate or imply that the work is being forwarded at the best possible rate of speed.

WOODSTOWN, N. J., is said to have conceived a passion for electric lighting, and the Woodstown Light, Heat and Power Company has been formed to satisfy it. The Company is to have a half-paid in capital of $25,000, and will operate under the Thomson-Houston system.

AT the annual meeting of the Burlington (Vt.) Gas Light Company the following Directors were chosen: Messrs. G. L. Linsley, Wm. Wells, B. B. Smalley, U. A. Woodbury, J. S. Pierson, A. G. Pierce and F. H. Parker.

MESSRS. BARTLETT, HAYWARD & COMPANY are to build the new holder for the Duluth (Minn.) Gas and Water Company. Vice-President Carey evidently intends that the Duluth Company shall be in position this winter to meet every demand that can be made upon its resources.

WE are indebted to an esteemed correspondent for the following: "The Board of Directors of the Columbus (Ga.) Gas Light Company held a meeting at the office of the President, Col. T. E, Blanchard, on the afternoon of July 1st. The affairs of the Company were found to be in a highly satisfactory condition and on a sound financial basis, and a semi-annual dividend of 5 per cent. was declared, payable on demand. The Board then adjourned and immediately the annual meeting was held. There was a full meeting, nearly all of the stockholders being present or represented by proxy. Messrs. W. L. Clark, T. E. Blanchard, J. B. Holst, C. B. Grimes and D. F. Willcox were re-elected as the Board of Direetors for the ensuing year. The Board then organized by re-electing T. E. Blanchard as President, T. D. Huff as Secretary and Treasurer, and E. H. Jenkins, Superintendent. The stockholders feel very much encouraged at the status of the Company. They had ordered a new purifying house and gasholder to be built several months ago, and this work, which is being done in the best possible manner, will be completed in about six or seven weeks. After this work has been done the Company will be prepared to furnish plenty of the best gas that can be made; and they feel assured that all of their customers will be pleased, and that their business will be largely increased. As an earnest of the Directors' desire to at once satisfy the public and enlarge their business, it is about settled that a reduction in gas rates will be announced on or about October 1st." It pleases us to be able to add that as it is in Columbus so also does it seem to be in almost every other Southern situation so far as the gas business is concerned. The gain in output is without exception gratifyingly large, and, better still, the number of individual consumers augments in about equal ratio with the gain in consumption. Emboldened by this state of affairs, the proprietors of the companies are contemplating plans, which in many instances will amount to virtual renewals, on an enlarged scale, too, of existing plants, many of which it may be fairly said have outlived their usefulness—that is, considered from a manufacturing point of view. In fact, we think we are safe in making the prediction that gas works builders will have much to do in the Southern and Southwestern States next season.

THE oystermen of Perth Amboy, N. J., say that the refuse discharged into the Raritan River from the works of the local Gas Company is causing great havoc among the oyster beds of the vicinity. The oystermen may be right in their conclusions, but it might perhaps be in order before accepting the charge as truthful to inquire about the likelihood of the pollution having a source other than the gas works. We do not believe it would be a very difficult task to prove that the latter is the case.

THE Amherst (Mass.) Gas Company, in furtherance of the design of its proprietors to operate an electric lighting plant, is carrying on a ser-

ies of experiments with a gas engine to determine whether or not power for the electric lighting annex shall be of gaseous derivation. It is quite likely that gas will hold its own in the tests.

THE Long Branch (N. J.) Electric Light Company has changed hands, and is virtually under control of those who operate the Long Branch Gas Light Company. The officers chosen are: President, H. E. Gawtry; Directors, Geo. N. Curtis, Hon. Rufus Blodgett, D. M. Hildreth, Geo. F. Baker, and H. E. Gawtry. The Company, under the terms of its franchise, has to pay $250 per annum to the town, and will supply both arc and incandescent lights.

THE residents of Havana, Cuba, seem to believe firmly in gas, for the business of the Spanish-American Light, Heat and Power Company for last month shows a 10 per cent. increase over its fellow in 1888. This increase, too, it should be borne in mind, was scored with an arc lighting service in the field in June, 1889, while the field was free from any sort of competition in 1888. Competition is not written here to indicate that the electric lighting supply is in independent hands, for it is in reality controlled by the gas company.

IT is just as we supposed it would be in respect to the plans of the parties who have recently been posing before Councils in certain sections of this State as the champions of cheap gas, asking for gas franchises, etc. We intimated that the Watertown coterie had no intention of building a works—certainly not if they could only frighten the existing Company into selling out to them—and corroboration is found in the fact that Messrs. Brown, Clark & Co. have made a proposition to Mr. Story for the purchase of his interest in the Watertown Gas Company.

THE following, concerning the plan of the St. Louis gas syndicate, is from the St. Louis *Post-Dispatch*: "At a meeting of the Board of Trustees of the St. Louis Gas Trust Agreement, the preliminary steps were taken for abandoning the Trust organization and placing all the properties under the operation of the Laclede charter. Mr. McMillin, the newly-elected President of the Laclede Company, and who will be at the head of the management of the affairs of the new Laclede, believes in a large consumption of gas at $1 per 1,000, rather than in a limited consumption at $1.50. It is also pretty certain that the syndicate will undertake to furnish cheap arc and incandescent electric lights, without any regard to any possible war on gas, and simply as a business. It has recently been determined that a gas company is for all practical purposes an illuminating company, and is empowered to furnish any illuminant in existence. Hence a new charter or franchise is not necessary to make the addition of electric lighting. The Laclede charter, too, is especially strong in giving this privilege. Upon this basis the Laclede syndicate has determined to, as soon as possible, erect a large electric light plant for furnishing both arc and incandescent, and at a price which will place the service on a basis with gas. At the same time the gas plants will be improved, and a fuel gas feature added, so that gas can be furnished at not to exceed $1 per 1,000 cubic feet. The improvements will nearly all be made at the old works of the St. Louis Gas Light Company, at Convent and Second streets. The old works will be improved, enlarged and modernized. The electric light plant and the gas works will be operated by the same power, so that the cost of both will be greatly reduced in comparison. The expenditures in the improvements will be in the neighborhood of $1,000,000, possibly more, and if it is found necessary to perfect the two plants according to the most modern plans the amount will be increased. The electric light plant will be represented under the same capitalization as the gas, and the earnings will be in common, the dividend being declared as one business. The finances for the electric light enterprises are assured by there being $1,500,000 bonds and the same amount of preferred stock in the syndicate treasury. Although it is not anticipated that it will be necessary, it is possible that the bond issue will be increased to cover the electric light feature, but it is more probable that the bonds now out will be extended to cover the electric plant. The work will be begun as soon as possible and its completion will then be a matter of but a short time. President McMillin will be in charge of the electric as well as the gas works, and will not endeavor to cut the prices of other companies so much as to give light—gas or electric—at a price which will be reasonable to the consumer and at the same time return a fair profit. The old St. Louis works were erected in 1846-7, and gas was first furnished from them on November 4, 1847. The construction of the works had been commenced in 1840, but the enterprise was abandoned, to be revivified in 1846—this was on account of the banking feature of the company's charter. The charter of the Company was granted in 1837, but the banking feature was so much more promising than the gas one, from which the company took its name, that the manufacture of gas was indefinitely postponed. The works were erected complete, at a cost of $130,000, by G. F. Lee, of Philadelphia.

A RATHER mysterious corporation has been registered in the County Clerk's office (Newark, N. J.), under the name of the Interior Construction and Improvement Company. It is to operate in Orange, Elizabeth, Hoboken and Jersey City, and its objects are: The transportation of goods, merchandise, and passengers upon land and water; inland navigation and the furnishing of power therefor; the building of houses, vessels, wharves and docks, railroads, telegraph or telephone lines; the laying of pipes for the transportation of natural or manufactured gas. The total amount of capital stock is $1,000,000, and the company starts with $1,000 paid in. The incorporators are: Camille Weidenfeld and Albert R. Eddy, of Orange; Henry S. Roll, of Hoboken; Jno. Byrne, Jno. A. Bouers, Jno. V. Rudd, W. F. Adlum, and L. F. Wilson, of New York; Clarence M. Smith, of Rosebank, N. Y.; and A. Eugene Hesdra, Brooklyn, N. Y.

THE certificate incorporating the Empire Gas and Electric Light Company, of Suffolk County, L. I.—this is the company that under the direction of Mr. Geo. Olney proposes to construct a gas works in the town of Huntington, L. I.—has been filed. The capital stock is fixed at $200,000.

SOME time ago we noted that the Cape Island (N. J.) Gas Company had been purchased by a syndicate, with which ex-Congressman Ferrell was prominently identified. On the 2d inst. the syndicate took possession, inaugurated the annual meeting and elected the following officers: President, Hon. Thomas M. Ferrell; Secretary, S. W. Van Syckel; Treasurer and Superintendent, Frederick Melvin.

THE Mayor and Comptroller of Chicago have been instructed to advertise for bids for lighting, extinguishing and cleaning all the gas burners and lanterns now maintained in that city. We understand that one firm offered to perform the work at the rate $3.25 per lamp per annum.

MESSRS. O'HARA and Beach are interested in the Gas, Oil and Fuel Company, of Litchfield, Ills., which it is said is to be a fuel gas venture. They assert that the plant will be in operation by December 15, but we do not think they mean December 15, 1889. Later than that, probably.

AMONG the orders recently received by Mr. Adam Weber, of this city, are the following: Bay City (Mich) Gas Company, two benches of 6's, with improved half-depth recuperative furnaces; Hackensack (N. J.) Gas Light Company, two benches of 3's complete, with new and improved settings.

THE proprietors of the Grand Forks (Dakota) Gas and Electric Company are putting in a second Springer cupola, to have a capacity of 80,000 cubic feet.

SOME time ago we noted the formation of a new gas company at Superior, Wis. The proprietors have now completed all the details of organization, and have decided to operate a plant of the Springer type. The generating apparatus is to consist of a double 6-ft. set, the per diem capacity of same to be 250,000 cubic feet.

BY way of Toronto, Canada, we are treated to the following concerning the lighting or non-lighting of Hamilton: "After all the talk indulged in during the past few weeks by the members of the City Council about lighting the city nothing of any moment has yet been accomplished. Three companies want to furnish light to the city, but the city fathers have been unable to agree upon what kind of light would be the best for all purposes. The Board of Works adhered to their report recommending the adoption of the Heisler incandescent system; but a strong objection was raised to making a 5-years' contract, the City Solicitor stating that in his opinion city contracts for supplies should be made for one year only. On the evening of June 26th the Board of Works held a meeting to reconsider the matter and discuss the objections raised to letting the lighting contract for 5 years, and after the case had been pretty well gone over it was decided that as the Council had granted the Board permission to advertise for tenders for 5 years, the Board should advertise for tenders for lighting the city for that time, beginning September 1st, next. The tenders will call for 230 to 250 arc lights of the same power as those now in use, or 700 to 750 gas lights, or 700 to 750 incandescent electric lights of 30-candle power each; also, for lighting a portion of the city with 100 to 150 arc lights, and the remainder with 400 or 500 incandescent lights; all lights to burn from dark to day-

light every night of the year; the lights to be located wherever the City Engineer may direct, and additional lights are to be furnished at the same proportionate rate."

THE Board of Directors chosen at the July meeting (held a fortnight ago) of the Troy (N. Y.) Gas Light Company are not to be considered permanent, since they will act as such only up to the time that the organization of the consolidated local Company is effected. At its meeting in June the old Board of Directors in the Citizens Company were re-chosen. However, at a meeting soon to be held the sifting process will be gone through with and the permanent organization completed.

MR. ADDICKS says that he hopes "to be ready to commence operations in Wilmington, Del., by Christmas." We thought he had commenced operations there already.

THE town of St. Johns, Canada, is pluming itself greatly over the fact that it has had arc street lighting since last Dominion day. It may not be so enthusiastic about it a year from now.

THE Excelsior Gas Company, of Aurora, Ills., has selected the following officers: Directors, Hon. H. H. Evans, Peter English, E. W. Trask. G. F. Watson and W. S. Beaupre; President and Treasurer, Peter English; Secretary, Frank English.

THE bill before the St. Louis Council authorizing the city to sell its gas stock—200 shares in the old St. Louis Gas Company—having been reported favorably, by Mr. Nelson, Chairman of the Committee on Ways and Means, the rules, on motion of Comptroller Stevenson, were suspended and the bill taken up for immediate consideration. Mr. Nelson urged upon the members the fact that the committee in considering the bill were convinced that the $375 per share which the city would be able to realize on its stock at this time would be even more than they would receive by holding the stock until the affairs of the Company were wound up next year. He stated that the committee had also considered the best disposition to make of the receipts in the event of the shares being sold, and the determination was reached that the proceeds should be added to the sinking fund. The bill was ordered engrossed, and there is slight reason for doubting that it will eventually become a law.

THE New York *Tribune*, in alluding to the meeting of the New York City Gas Commission (held on the 9th inst.), at which it was proposed to make the awards for arc street lighting, on the basis of the second set of bids received—the June bids were rejected at that time and new bids asked for—says that the former sweet harmony of the electric lighting companies, as shown by the unanimity of their bidding in June, appeared to be badly shattered. The Brush Company made the first demonstration by entering a protest—evidently aimed against the Mount Morris Company—to the effect that bids from companies having no wires in the territory bid for should not be received. Then the East River Company fired a shot into United States Company's expectations in the shape of a protest against the reception of the latter's bid, declaring it informal as well as untrue in the statement that no other Company was interested in its bid. Mayor Grant expressed his astonishment at this show of war paint and tomahawks, and desired to be informed how it was when the first bids were made that all put in the same figures, if there was no collusion then. This query of the Mayor's, as might well be understood, was received in disdainful silence. The protests, together with the bids attacked, were referred to the Corporation Counsel for his opinion as to the legality of the bidding, and the Commission adjourned until tomorrow, when it is likely the awards will be made.

THE bids submitted under the second invitation are as follows:

Company.	No. Lamps.	Rate per Light per Night.
United States	282	25 cents.
"	176	29 "
"	334	35 "
Brush	371	35 "
"	70	45 "
East River	387	35 "
"	21	44 "
Mount Morris	378	20 "
" "	139	21 "
" "	72	22 "
" "	22	25 "
Harlem Lighting	49	35 "
" "	19	50 "

The difference in the bids is partly accounted for on the ground that the lower rates are offered in districts where competition is possible. Again, lights furnished in the district where the subway must be availed of are charged for at a higher rate than those in the overhead district. For instance, the Brush Company wants 45 cents for lights in the subway district, which is 10 cents more than that charged for a similar service outside of it. The average difference charged by the other bidders (within and without subway lines) is about 9 cents per light.

THE authorities of Wilmington, Del., have instructed the gas company to replace with gas lamps all the gasoline lamps in the western part of the city on streets in which gas mains are laid.

WE have it officially that Mr. W. A. Stedman is to be Managing Engineer of the amalgamated gas interests of Rochester, N. Y. We congratulate the Company.

THE authorities of St. Paul, Minn., have also determined to as far as possible replace gasoline street lamps with lamps of the orthodox variety.

THE Committee on Contracts of the Quincy (Mass.) City Council have ordered—subject to the approval of the Council, which is virtually granted—"that a contract be made with the Citizens Gas Light Company to furnish gas for street lamps, until March 1, 1890, at 85 cents per month per light, each lamp to be equipped with a 5-ft. burner, and lighted from dark to midnight, moon schedule, the care of said lamps to be assumed by the Commissioner of Public Works."

THE premises, No. 2,417 Wright street, Philadelphia, was not long ago the scene of a gas explosion, caused, it is said, by the carelessness of an employee of the Gas Bureau. The employee was hunting for a gas leak, and was trying to find the scent with the aid of a lighted match. His idiocy is likely to cost the city a good round sum; for the tenant occupying the place has brought suit for $500 damages to furniture, etc., while the owner of the building is about to sue for $2,000 damages to his property.

AT a meeting of the Board of Aldermen, Charlestown, Mass., it was ordered that the Charlestown Gas Company be allowed, under the direction of the Superintendent of Common and Public Grounds, to erect 3 iron poles for the support of electric wires on Winthrop square. The reason for this special authorization is found in the fact that the poles were to be placed on city property.

CHARLES IDE, Assistant Superintendent of the Minneapolis (Minn.) Gas Light Company, was drowned in Lake Harriet on the afternoon of the 7th inst. To make it still more sad, deceased was in company with his betrothed—Miss Langdon—who also met her death at the same time. The couple had been enjoying a boating expedition, and were lost through the overturning of their boat.

THE proprietors of the Lawrence (Mass.) Gas Company will appeal to the Gas Commissioners from the action of the local Board of Selectmen in granting a franchise to the newly-organized "Thomson-Houston Gas Light Company" for Methuen, Mass. One of the points in the appeal will be based on the provision of the law which states that where a company is already in active operation, no permit shall be granted another company without the preliminary of a public hearing. The latter was omitted in the Methuen instance. This will be about as nice a point as the Commissioners have yet been called upon to decide.

IN the meantime, the incorporators of the Methuen separate company are getting ready to receive estimates for plant, etc.

WE understand that the incorporators of the Revere (Mass.) Gas Light Company have been granted a franchise for the operation of a gas and electric light plant by the Selectmen of that town. The Company is officered as follows: President, W. W. Lowe; Vice-President, C. C. McCabe; Treasurer, D. Morgan Crosby; Secretary, W. F. Bryant. This place is a township in Suffolk county, Mass., and is 4 miles northeast of Boston. In fact, its post office is a branch of the Boston post office. It is a pleasure resort for Boston people, and is noted for its beautiful beach, which is washed by the waters of Massachusetts Bay.

MR. J. WILLS HUMBIRD, of Cumberland, Md., has purchased a controlling interest in the property known as the Black Band Mining Company, of Kanawha, West Va. He proposes to work the property thoroughly, and will devote especial attention to the placing on the market of what is known as the "Birdseye Cannel," which he claims is an extension of the Peytona cannel seam. The vein is but 24 inches thick, but can be easily worked.

CONSIDERABLE improvement is being made on the plant of the Waterbury (Conn.) Gas Light Company.

OF the 78 gas companies in Massachusetts, 19 are engaged also in the supply of electric light.

OAKLAND, Cal., pays $2.25 per thousand cubic feet for the gas consumed in its public buildings, 10½ cents per night for each street gas lamp maintained, and $8.75 per month for each 2,000-candle power arc employed. The arcs are in duty from one-half hour after sunset to midnight of each and every night.

MR. C. W. HINMAN, Gas Inspector for Massachusetts, is again doing credit to himself and his country in the contests on the English rifle ranges. His score is always of the reliable, steady sort.

The Gas Pavilion, Paris Exposition.

One of the attractive features of the great Paris Exhibition is the section known as the gas pavilion, the opening of which (on May 31) was made at a time, perhaps, when everything was not quite ready. Now, however, all friction has been done away with, and the pavilion is a most enjoyable spot. The *Journal 'des Usines a Gaz* prints the following description of the manner in which the place is arranged to display its original purpose—to afford visitors an opportunity of examining how gas may be applied for lighting, heating, ventilation and motive power.

Commencing with the basement, the gas engine gallery contains samples of the motors of Lenoir, Otto, Ravel, De Forest, and other makers, of varying capacities up to and even beyond 50-horse power. These engines are not merely exhibited for show; they are actually employed in working centrifugal pumps which raise the water for all the purposes of the building, particularly for the lift, and one drives the generator for furnishing the electricity used for lighting the parlor on the first floor. The lighting of the engine gallery is done mainly by groups of albocarbon lamps. The experiment gallery consists of a chemical laboratory and a complete collection of photometric apparatus, all furnished with the latest improvements. The kitchen contains a very large gas oven, fixed under a hood, with all the necessary accessories—grillers, pastry ovens, etc. It is lighted by four ventilating regenerative Wenham lamps; the products of combustion being carried out of the building by special conduits in the ceiling. The circular space in the basement, set apart for the display of gas lighting and heating appliances, contains a large assortment of these articles, in the arrangement of which no attempt has been made at effect—their purpose being purely industrial.

On the ground floor, the library (a room in carved oak) is lighted by a luster composed of twelve regenerative burners enclosed in tinted glasses. Against the wall there is a case containing samples of all the coloring materials and of the derivatives of coal tar employed for industrial purposes. The smoking-room, arranged in the Oriental style, is lighted by a luster in keeping with the general character of the apartment, and fitted with Welsbach burners. The walls of the grill-room are decorated with artistic tiles. In a fireplace of large dimensions, there is placed the grill, fixed after the English fashion, which allows visitors to see grilling by gas actually in operation. This room is lighted by a sunburner of pretty pattern in the center, with four Siemens burners in the corners. The lecture hall occupies almost the entire height of the building and is covered by a glass dome. The place of honor is given to a statue of Philippe Lebon, the inventor of gas lighting. This statue is similar to the one erected under the auspices of the Societe Technique not long ago at Chaumont, Lebon's native place. Upon the walls below the cornice are the names of the illustrious men whose combined efforts resulted in establishing the gas industry. Murdoch, Clegg, Dumas, Regnault, Siemens, Pauwels, Pelouze, and others. A large central luster, of the kind used in theatres, lights the hall, with the assistance of eight small lusters disposed round the walls. The historical exhibition consists of a valuable and interesting collection, brought together with considerable difficulty by a distinguished *savant*—M. Dallemagne—and comprising specimens of all kinds of ancient lighting appliances, from the Roman lamp down to the luster of the First Empire. All the samples have been carefully classified, and are exhibited with their date and history attached. Wenham ventilating lamps supply the light for this gallery, which is one of the curiosities of the pavilion.

The first floor contains some elegantly furnished rooms. The drawing-room, which is luxuriously fitted up in the Louis XVI. style, is lighted principally by an exceedingly beautiful luster; and the floral verandah, into which the room extends, by incandescent gas lamps. The parlor is furnished in the Louis XV. style; and, as before stated, it is lighted by electricity. The object of the Organizing Committee in making use of this illuminant was to show that, as a "light of luxury," it might be effectively used in certain apartments; and that when so employed the gas engine is one of the simplest forms of motive power that can be utilized for the purpose of generating it. The bed-room is a marvel of elegance; everything being arranged to accord with modern notions of convenience and comfort. A special feature in connection with the gas fires in this and the preceding rooms is that the asbestos appears like a coral when it becomes incandescent under the action of heat. The work-room is lighted by a luster of hammered iron, as well as by two elegant brackets on the walls. The general lighting of the billiard-room is effected by a new method—a luminous cornice. A special billiard-table light, with Chabot burners, completes the arrangements. The luster which lights the dining-room is composed of eight recuperative burners, arranged in a circle round a central burner, and so fitted into the ceiling that while the table beneath is effectively illuminated, the atmosphere of the room is kept fresh and pure.

Coming to the exterior of the building, the dome already referred to is surmounted by a figure bearing two powerful gas torches, the flames of which light up the side of the neighboring Eiffel Tower. A row of gas jets illuminates the dome; and upon other parts of the roof powerful gas lights lend their aid to make an effective display.

The Arctos Refrigerator.

Messrs. A. M. Perkins & Son, according to *Engineering*, have within the past two years, as the result of continuous experiment, perfected a system of refrigerating plant which, though in principle well known, is novel in its practical application. It is, in short, an ammonia absorption plant without any moving part whatever; there is not even a single cock or valve used in the apparatus, which consists solely of a combination of wrought iron pipes of various diameters connected by screw joints only. Two horizontal cylindrical vessels are placed one above the other at a short distance apart; they are joined by a vertical pipe which projects into each as far as the center line. Out of the top of the upper vessel a second pipe issues, of inverted U shape. This pipe is connected at its remote end with the top of a third cylindrical vessel, which latter is placed in the refrigerating chamber, while below the first chamber is a heating apparatus. This first vessel is half filled with hydrous ammonia, as is also the one above, while the U-shaped tube is surrounded by a water jacket. Heat being applied to the lower vessel the ammonia is evaporated, the gas rises in the water-cooled tube, is condensed and collects as liquid ammonia in the refrigerating vessel. During the process of boiling some water is, of course, evaporated, and is condensed with the ammonia in the refrigerating vessel, but the two liquids being of different specific gravities, the water is separated by means of an ingenious syphon arrangement, and returned automatically back to the first boiling cylinder.

The heating process is continued until all the ammonia is driven out of the water; the temperature rises up to 270° F., and the pressure varies from 150 pounds down to 60 pounds per square inch in the apparatus. The source of heat is now withdrawn, and a spray of water turned on to play over the whole surface of the two cylindrical vessels, reducing the pressure in these and causing the liquid ammonia to re-evaporate, and pass as ammonia gas from the third vessel back into the second and first, where the water rapidly absorbs it, at the same time producing extreme cold in and around the third vessel. The process is thus an intermittent one of alternately boiling, condensing and re-evaporating. Mr. Perkins has at his works several apparatus of this kind at work, some quite small for experimental purposes, by means of which a temperature of 50° below zero—or, roughly speaking, 80° or more of cold—can be produced (sufficient to freeze mercury), and he expects to get very far beyond this temperature. Other small gas-heated apparatus are used to keep chambers of various dimensions cold, the temperature in most of these being maintained at about 20° to 22° of frost; they are used by various London poulterers and fishmongers as cold storage rooms for perishable articles. Most of these are heated by Perkins' high-pressure heating system, the small heating pipes being inserted into the lowest vessel previously described.

One of the chambers at the works is 40 ft. long, 6 ft. wide, and 7 ft. high; it has two refrigerating cylinders about 12 in. in diameter and 10 ft. long in it, while the two boiling vessels are of somewhat larger dimensions. This chamber is filled with a large supply of game and other perishable articles. It is kept cool by the boiling being carried on for about three hours during every twelve hours by means of a branch off the shop-heating apparatus, while the re-evaporation occupies about nine hours. Ice has been frozen in this chamber in blocks 20 in. by 20 in. by 15 in., but the plant is not fitted for the manufacture of ice, with which problem Mr. Perkins is, however, at present occupied. Two plants for refrigeration on a moderate scale are at present in course of construction in the workshop, and we hope on completion of these to be able to place some complete data on record.

It is, however, certain that the extreme simplicity of the plant, the entire absence of machinery, and, indeed, of all moving parts, together with freedom from leakage and danger of all kinds, must strongly recommend it; while there appears no reason why it should not work with great economy, since it is a perfectly closed complete cycle, requiring neither attendance nor refilling, and only the temporary application of heat and cooling water. For domestic and small dealers' use this apparatus appears in its present form to be the very thing wanted and should be in very great demand.

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Germany.—B. WESTERMANN &CO., of New York.

MONDAY, JULY 15, 1889.

How Creosote Affects Chimney Flues.

Attention has more than once been called to the peculiarly corrosive, and consequently destructive, effects of the creosote of wood soot upon chimneys, owing to the fact that the creosote thus formed from the slow combustion of wood contains so large a proportion of pyroligneous vinegar or crude acetic acid; this acid being formed in large quantities when the combustion of wood is slow, many quarts, in fact, being condensed in cold weather where a large wood fire is very much checked, only a few hours being required for such condensation. The acid in question dissolves lime readily, carrying it away in solution, and in this manner the mortar is frequently entirely removed from the tops of chimneys in the country, new ones suffering in the same way as the old, instances being numerous where the top courses of bricks in chimneys only two years old have become entirely without support other than that afforded by the sand with which the lime was mixed.

Oil as a Fuel for Metallurgical Purposes.

At a recent meeting of the American Institute of Mining Engineers, one of the topics discussed at length was that named above. Mr. G. W. Billings gave the following as his experience in the matter: It took 3,518 lbs. of oil to heat the furnace to a point suitable for charging. The Company used 8,437 lbs. of oil then to produce 13,340 lbs. of puddled blooms. The expense of using oil for 1 ton of blooms was $10, or per day, the oil cost $62.18, as against $41.68 per day for coal. The total saving in favor of coal for 1 year was found to be $9,040, about one-third more than the daily record showed. In another puddling furnace they obtain a saving in favor of coal of $12,065.04 per annum. In steam boilers at the same place they obtained a saving of $40,307.40 in favor of coal.

Mr. E. C. Porter, of the North Chicago Rolling Mill, gave as his experience that the use of fuel oil enabled his Company to dispense with the services of a number of men, that the efficiency of the boilers was somewhat increased, and the repairs materially lessened. The cleanliness of the fuel, and the ease of regulation, and the uniformity of supply, made it to his mind a desirable substitute. The battery of boilers tested consisted of 26, and he saved the employment of 38 men in 24 hours, which he considered to mean $76 per day.

There were other views given, showing both sides of the question. The whole problem centers on the relative prices of coal and oil at the point of trial, and these were so varied that the question failed of a satisfactory solution. Enough was developed, however, to warrant the belief that oil will be found cheaper for some processes, but that the present method of application has not obtained the best results.

THE JOHNSTOWN (N. Y.) GAS COMPANY'S LUCKY ESCAPE.—Early last week Johnstown, N. Y., was partially submerged, because of the overflow from Cayadutta Creek. The recent heavy rains were too much for the ordinary carrying capacity of the creek, and the first reports went to show that Johnstown was completely under water. While the actual state of affairs was bad enough, we are nevertheless pleased to say that the first account of the damage done was exaggerated. Superintendent Lorenz, of the local gas works, telegraphs us that the Company did not suffer greatly, although at one time the large gasholder was in danger. The electric light company's station was submerged, and the driving machinery and dynamos were badly damaged. This cuts off the public illumination, and the commercial lighting as well. The electricians hope to resume some time this week.

The Market for Gas Securities.

The market for city gas shares shows no sign of returning animation, and quotations are about as before, save in respect to Mutual, which is rated at 101–102, ex-dividend. This stock is a purchase. In Brooklyn shares the prevailing feature is that of strength. Old Brooklyn is at 107½ to 108½, and Fulton-Municipal more than holds its own. There is some talk of the Rochester syndicate securing control of the Citizens Company, of that city; but it is likely that the desires of holders as to the figure wanted by them will prevent or delay the deal. Chicago Trusts are weaker, at 58¼, and Baltimore Consolidated is fairly steady, at 45½.

The New Bedford (Mass.) Company is disbursing its quarterly dividend of 2 per cent., and we have it on good authority that ere long the Company will have absorbed the local Edison concern. Treasurer Lee, of the Louisville (Ky.) Company, announces that the semi-annual dividend of 3 per cent. is payable on demand. Attention of investors is called to the advertisement offering "Bonds for Investment." The security is gilt-edged, and the return (6 per cent. per annum) is ample.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks.

16 WALL ST., NEW YORK CITY.

JULY 15.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	86¾	87
Central	500,000	50	—	—
" Scrip	220,000	—	—	—
Equitable	4,000,000	100	125	—
" Bonds	1,000,000	—	113	115
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	116	118
Mutual	3,500,000	100	101	102x
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
Yonkers		50	112	—
Richmond Co., S. I.	346,000	50	60	70
" Bonds	15,000	—	—	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	107½	108½
Citizens	1,200,000	20	67	70
" S. F. Bonds	320,000	1000	—	103
Fulton Municipal	3,000,000	100	127	130
" Bonds	300,000		—	106
Peoples	1,000,000	10	74	76
" Bonds (5's)	368,000	—	97	—
" " (6's)	94,000	—	100	—
Metropolitan	1,000,000	100	89	91
Nassau	1,000,000	25	111	—
" Ctfs	700,000	1000	100	103
Williamsburgh	1,000,000	50	120	122
" Bonds	1,000,000	—	109	112
Out of Town Gas Companies.				
Boston (Mass.) Gas Co.	2,500,000	500	240	—
Buffalo Mutual, N. Y.	750,000	100	90	95
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	170	—
" " Bonds	45,000	—	—	—
Chicago Gas Trust	25,000,000	100	58¼	—
Cincinnati G. & C. Co.	6,000,000	100	214	218
Consumers Toronto	1,000,000	50	196	—
Central, S. F., Cal.			75	90
Capital, Sacramento, Cal.			58	
Consolidated, Balt.	11,000,000	100	45	45½
" Bonds	6,400,000		107	107½
Hartford, Conn	750,000	25	120	130
Jersey City	750,000	20	175	180
Laclede, St. Louis, Mo.	2,000,000	100	140	—
Louisville, Ky.	2,570,000	50	125	130
Little Falls, N. Y.	50,000	100	—	100
" Bonds	25,000	—	100	103
Montreal, Canada	2,000,000	100	204	210
Memphis (Tenn.) Gas	750,000	100	48	51
" Bonds	240,000	100	103	—
New Haven, Conn		25	193	197
Oakland, Cal.			34	35
Peoples, Jersey City		—	60	61
" " Bonds			—	—
Paterson, N. J.		25	99	102
Rochester, N. Y.		50	99	100
Syracuse, N. Y.	500,000	25	—	—
St. Louis, Missouri	600,000	50	—	750
San Francisco Gas Co.			60	60½
San Francisco, Cal.	10,000,000	100	59¾	60
Washington, D. C.	2,000,000	20	195	198
Wilmington, Del.		50	200	208

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Bonds on Gas Works situated in growing Western towns, paying 6 per cent., interest semi-annually. For sale by the undersigned, who will furnish all necessary information regarding them.

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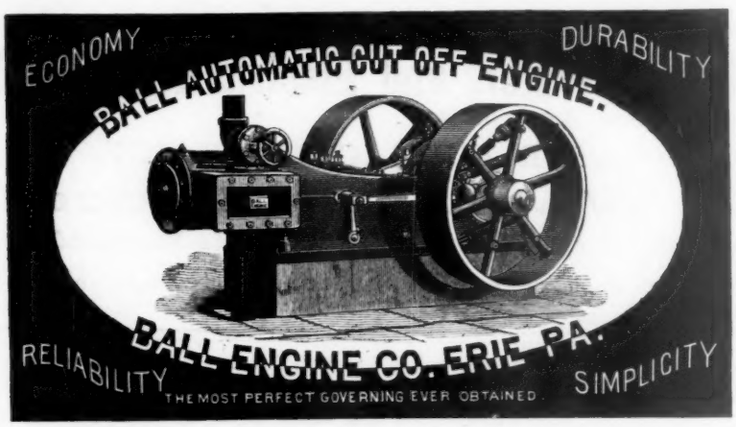

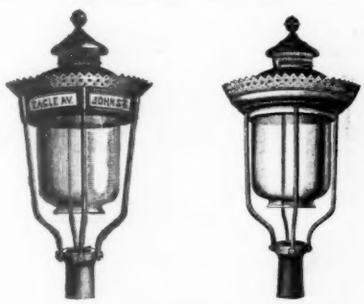

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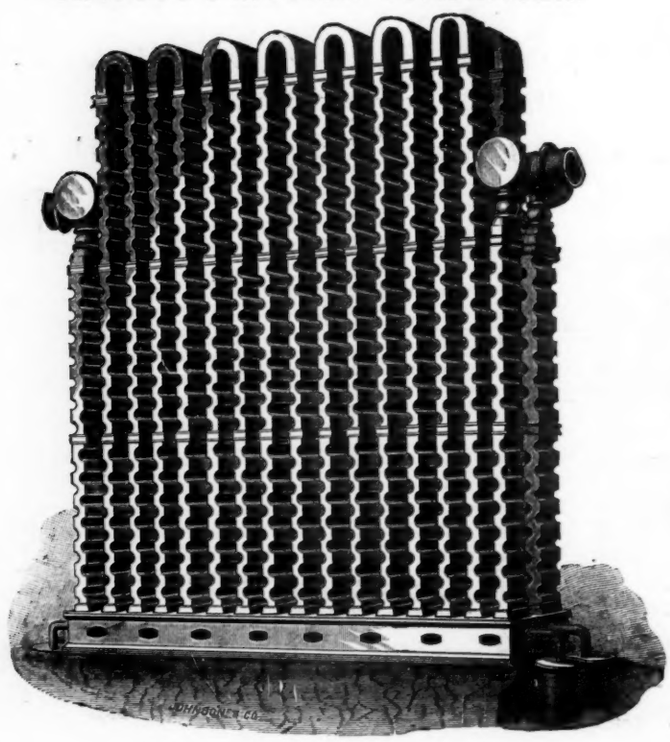

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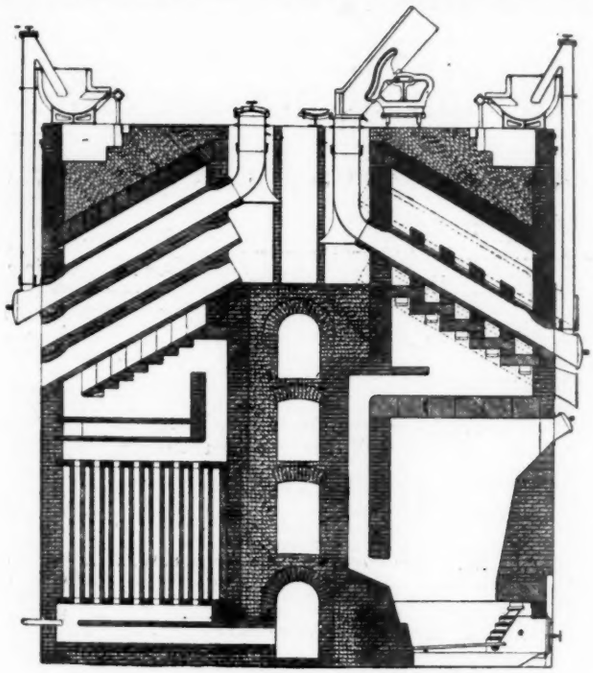

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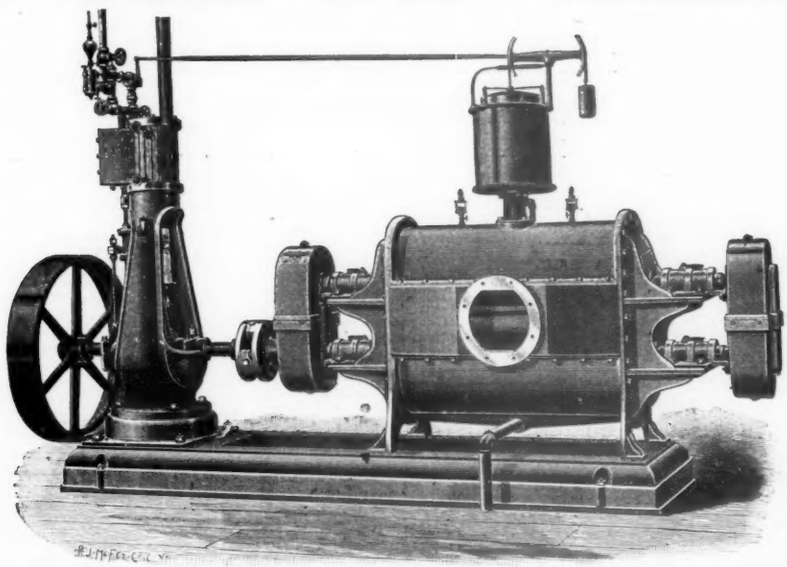

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Amsterdam	1,500,000
"	1,500,000
Annaberg	200,000
Arcachon	100,000
Animal Charcoal Co	200,000
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Buxton	250,000
Bradford	1,000,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,000,000
"	1,000,000
"	3,000,000
Bremen	150,000
Baltimore, U.S.A.	1,000,000
"	1,000,000
"	1,000,000
Balmain, N.S.W	125,000
Bishops Stortford	150,000
Blackpool	400,000
Brussels	1,250,000
"	1,250,000
"	750,000
"	1,250,000
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Birmingham	5,000,000
Birkenhead	2,500,000
Blackburn	1,500,000
Bochum	600,000
Burntisland	250,000
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Brisbane	1,500,000
"	300,000
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"	20,000
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"	1,000,000
" **Nassau**	1,000,000
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" "	1,000,000
" "	1,000,000
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Driffield	100,000
Dukenfield	500,000
Dover	750,000
"	1,000,000
Deal	200,000
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Douai	500,000
Denton	500,000
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Denver, "	500,000
" "	1,000,000
Dusseldorf	750,000
"	500,000
Dumfries	250,000
Dunedin, N.Z	400,000
Darlington	1,250,000
Detroit, U.S.A.	750,000
Edinburgh	1,500,000
"	2,000,000
Enfield	300,000
Essen	300,000
Elbing	150,000
Falmouth	150,000
Frankfort	300,000
Farnworth	400,000
Fenton	400,000
Friedenshutte	500,000
Furth	400,000
Freiburg	200,000
Goole	250,000
Glossop	300,000
Guildford	300,000
Gloucester	1,250,000
Gera	300,000
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Grieg	300,000
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Havana, Cuba	750,000
Hastings	1,500,000
Huddersfield	300,000
"	750,000
"	1,500,000
Hof	200,000
Hampton Wick	500,000
Heckmondwicke	500,000
Haverfordwest	100,000
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Hamm	200,000
Halle	400,000
Heidelberg	300,000
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"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	2,500,000
"	2,500,000
Silvertown	1,000,000
Bromley	2,000,000
"	1,500,000
"	1,500,000
"	1,500,000
"	2,000,000
"	1,500,000

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Pancras	1,500,000
"	1,500,000
Pimlico	2,000,000
Nine Elms	3,000,000
"	3,000,000
South Metropolitan Co:—	
Greenwich	3,000,000
Woolwich	400,000
Vauxhall	3,000,000
"	3,000,000
Lea Bridge	300,000
West Ham	1,500,000
Leeds	2,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	2,000,000
Leominster	150,000
Leiden	560,000
"	600,000
Liverpool	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	3,000,000
Lincoln	1,000,000
"	600,000
Lowell, U. S. A.	1,000,000
Louisville "	1,500,000
Long Eaton	500,000
Lilie	900,000
"	450,000
"	750,000
"	250,000
"	250,000
Luckenwalde	330,000
Liegwitz	300,000
Lincoln, U. S. A.	250,000
Lawrence "	500,000
Lynn "	300,000
Lyons	1,500,000
Maidstone	1,000,000
Marseilles	1,500,000
"	1,500,000
Mons	500,000
Malines	250,000
Melbourne	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
Manchester	2,500,000
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"	2,500,000
"	2,500,000
"	2,000,000
"	1,500,000
"	2,000,000
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"	300,000
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"	1,750,000
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"	1,000,000
"	2,500,000
"	50,000
"	50,000
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"	1,500,000
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"	2,000,000
"	1,000,000
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"	2,000,000
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"	600,000
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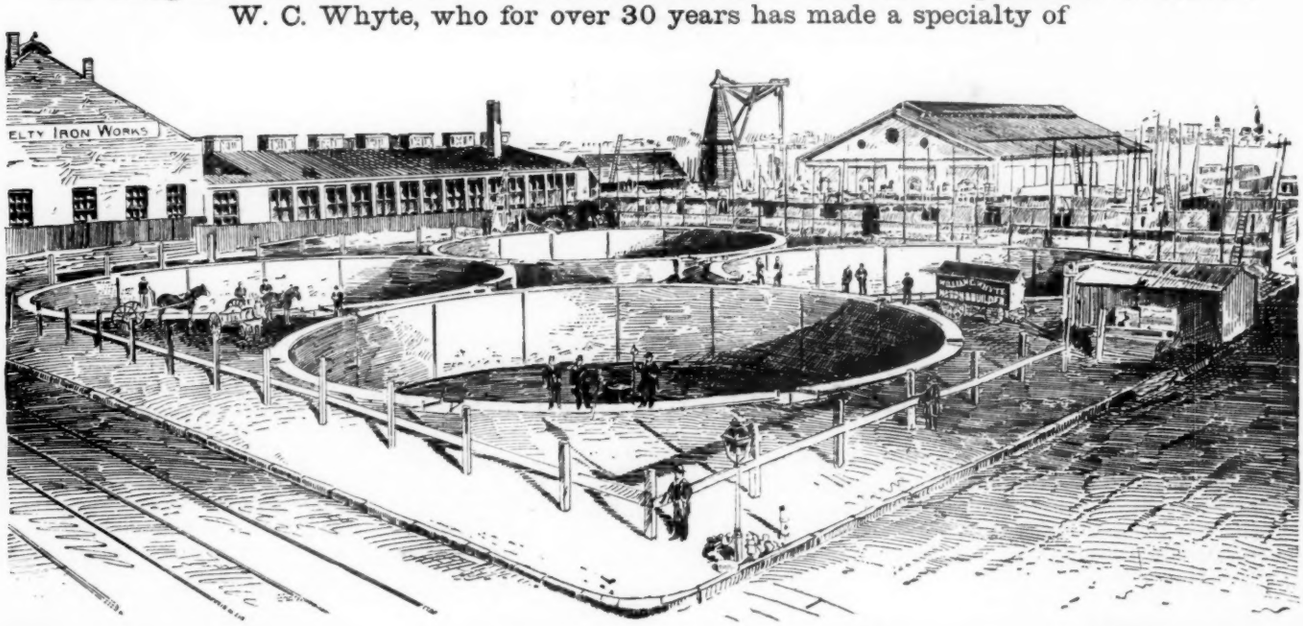

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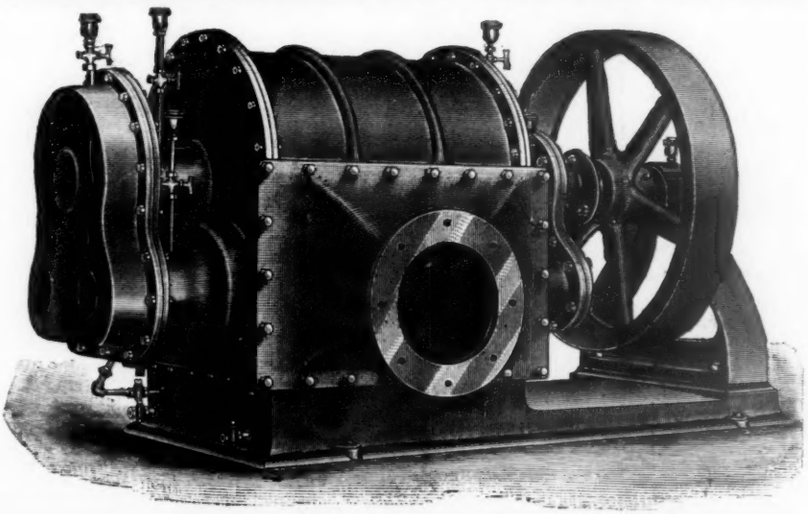

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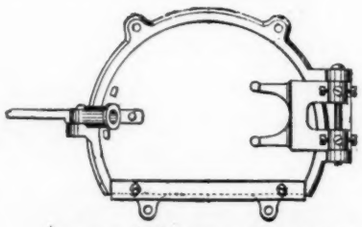

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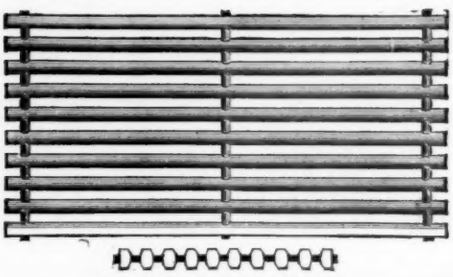

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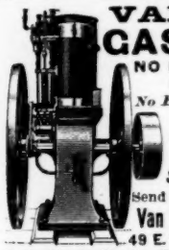

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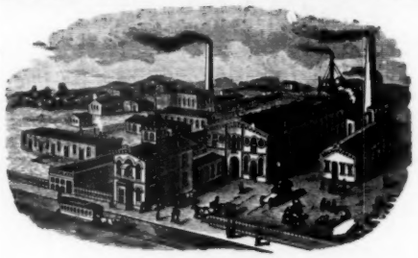

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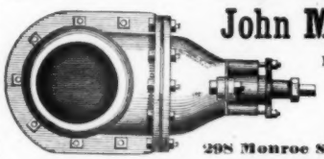

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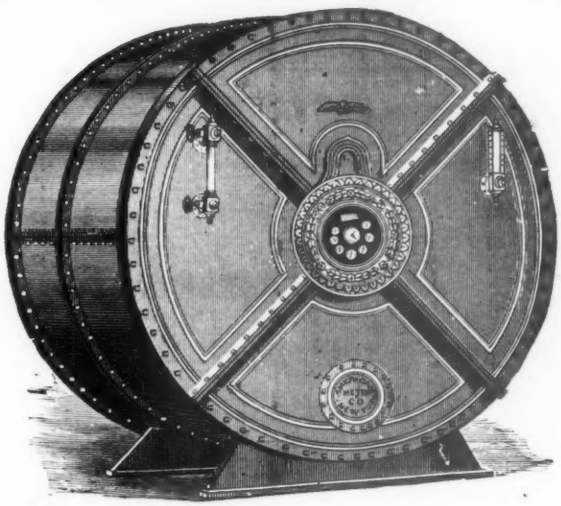

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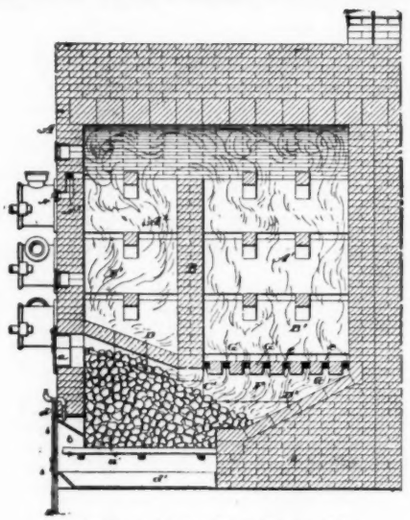

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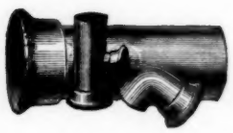

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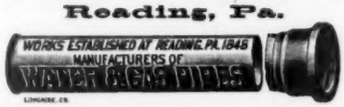

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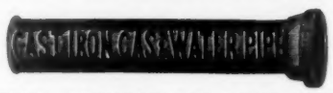

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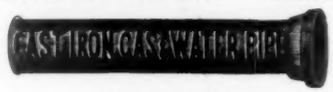

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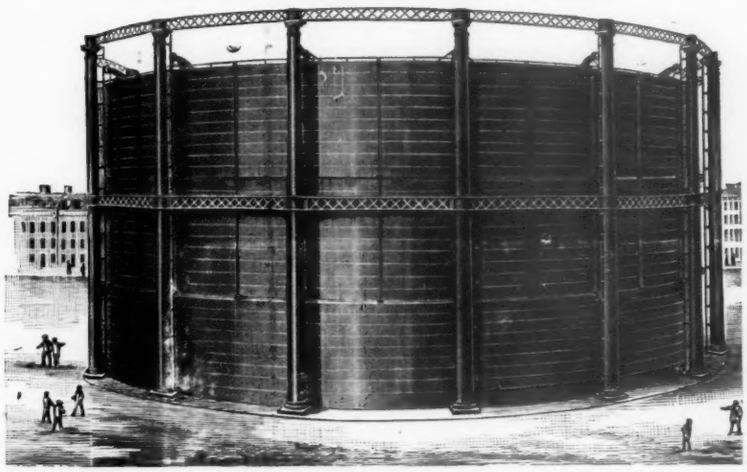

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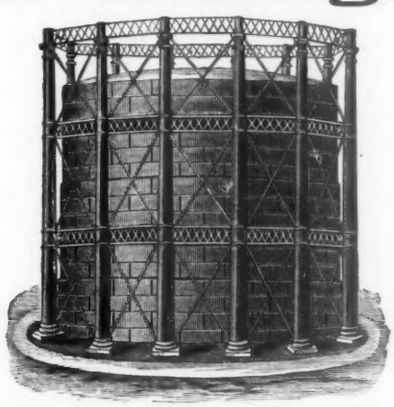

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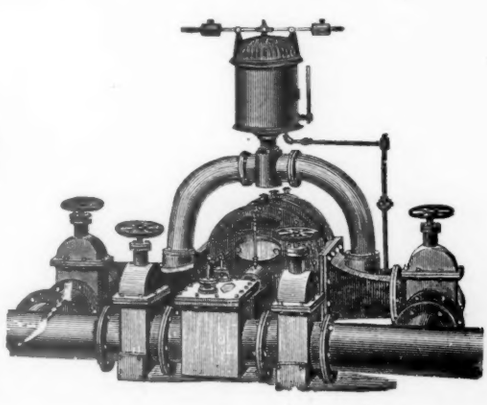

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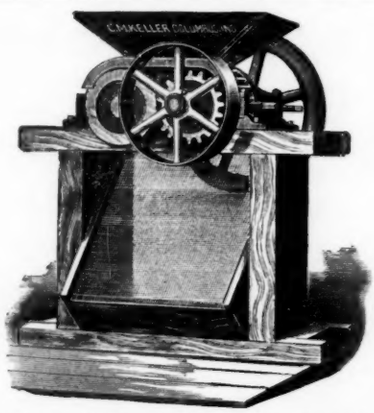

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50-H.P. STEAM ENGINE AND BOILER, Running a Plant of Fifty 2000-C.P. Arc Lamps 12 Hours.	
4,500 lbs. Indiana nut and slack, at $1.30 per ton	$2 93
Engineer, one night, at $50 per month	1 67
Trimmer, one day, at $40 per month	1 33
Superintendent or Electrician, one day, at $50 per month	1 66
Waste, etc., one day, at $20 per year	05
Water rent, one day, at $40 per year	11
Wheeling coal and removing ashes, at $4 per week	58
100 pairs carbons, at $18.50 per 1000	1 85
One pint cylinder oil, at 60 cents per gallon	07
One quart engine and dynamo oil, at 50 cents per gallon	13
Total	$10 38

50-H.P. OTTO GAS ENGINE, Running a Plant of Fifty 2000 C.P. Arc Lamps 12 Hours.	
9,200 cu. ft. gas, at 42 cts. per M. (for cost of gas see items below)	$3 86
Engineer not needed; engine is in care of Electrician or Supt.	....
Trimmer, one day, at $40 per month	1 33
Superintendent or electrician, one day, at $50 per month	1 66
Waste, etc., one day, at $20 per year	05
Water rent dispensed with (cooling water used over and over)	....
Handling of coal included in cost of gas	....
100 pairs carbons, at $18.50 per 1,000	1 85
One pint cylinder oil, at 60 cents per gallon	07
One quart engine and dynamo oil, at 50 cents per gallon	13
Total	$8 95

Expenses of depreciation, repairs, and interest omitted, being considered the same in both cases—though depreciation and repairs are much higher with steam on account of boiler and its appurtenances. Cost of gas in the holder we estimate for most of the Middle and Western States as follows: Coal, 30 cts.; labor, 20 cts.; purification, 2 cts.; total, 52 cts. Less coke, 7 cts., and tar, 3 cts.; leaving net cost of gas 42 cts. The items of Superintendence and repairs, being paid for by the gas sold to consumers, need not be charged on extra output for gas engine consumption. Where the cost of gas is higher than here figured, coal for steam use will be found proportionally higher, and final figures of comparison show same amount of saving.

Excess in Cost of Steam over Gas Power is thus $1.43, or nearly 16 per cent.

Coal for getting up steam and banking fires is not included in above figures, and should be added, thus increasing rate of economy of gas power beyond that shown by our figures.

Where Gas Companies adopt Gas Power for Electric Plants, Water Works, Sewerage, etc., they not only choose **the most economical power for their use,** but secure to themselves the **numerous advantages of increased production,** without increase of expense, and benefit thereby their entire manufacture. They induce consumers, by their example, to abandon Steam for Gas Power, and, by establishing special rates, make

Gas Power the Leading Power of To-Day,

AND SOLVE AT ONCE THE QUESTION OF FUEL GAS.

"Otto Gas Engine Works,"

SCHLEICHER, SCHUMM & CO.,

151 Monroe St. (Kent Building), Chicago. **33d and Walnut Sts., Phila.**

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